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AN ANALYSIS OF THE REPUBLIC OF CHINA AIR FORCE FMS DISTRIBUTION SYSTEM

THESIS

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THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technoloty

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Preface

Two things guided me naturally to embark on this thesis. One was a required thesis proposal when I took the Research Method course. In fact, that proposal eventually led to a completed thesis which was also one of the requirements for me to earn a degree of Master of Science at the Air Force Institute of Technology (AFIT). The other was an intention to make a systematic pilot study to diagnose any latent problems existed in the Republic of China Air Force (ROCAF) FMS distribution system, which serves as the main artery for the follow-on support of ROCAF's weapon systems. So the importance of this system to ROCAF can not be over-emphasized. As a liaison officer stationed at Wright-Patterson AFB and being a member of ROCAF, I was hoping that this thesis would make some valuable contributions to my air force.

I was elated when I found some problems in the distribution system. In reality, I was not delighted at seeing some problems, but rather, amazed at the power of the research methods and tools that I have learned at AFIT. For these, I am indebted to many faculty members for their endeavors and indoctrinations.

My sincere thanks goes to Major Hung-chuang Lan, Staff Officer of FMS Branch, Logistics Control Center in Tainan, Taiwan, for helping me collect some in-country data.

I am especially grateful to my faculty and thesis advisor, Lt Col Frederick W. Westfall. Without his wise guidance, farsightedness, patience and encouragement, I could not have possibly entered this rigorous program and accomplished the thesis.

Finally, I wish to thank my wife, Hui-ying, my children, Ya-ling, Pei-neng, and Pei-chen for their love, concern, patience, support and understanding during the period of strenuous work.

Te-chun Huang

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Abstract

This study had two objectives:

1. To analyze the ROCAF FMS distribution system and to identify its problems and causes, whenever possible, and

2. To make recommendations based on the findings of this research.

A total of four hundred and twenty (420) samples were collected for this study. These data were analyzed by using descriptive statistics to examine in detail the material's flow time at each individual link of the ROCAF FMS distribution system--starting from the shipment of materials by the sources of supply, through the freight forwarder and ROCAF's two transportation stations, till they were received by ROCAF's end users. Detailed discussions were presented under twenty-one (21) investigative questions.

Some problems or bottlenecks of the distribution system were revealed by this study. The causes of those problems were traced and could be categorized as process, manpower, management or equipment related.

Although the ROCAF FMS distribution system was plagued with some problems, there are certain ways that can be used to rid it of such problems and to enable materials to move smoothly through the entire system. Those possible solutions were proposed by this research. Finally, some recommendations for future researches were also made.

AN ANALYSIS OF
THE REPUBLIC OF CHINA AIR FORCE FMS DISTRIBUTION SYSTEM

I. Introduction

Background

Security assistance has been an essential element of the United States' foreign and national security policy for over forty years. The Reagan Administration also established six broad policy goals for security assistance:

1. Promote peace in the Middle East.
2. Enhance cooperative defense and security.
3. Deter and combat aggression.
4. Promote regional stability.
5. Promote key interests through Foreign Military Sales (FMS) cash sales and commercial military exports.
6. Promote professional military relationships through grant training (5:1-27 to 1-32).

Moreover, the former Secretary of State George P. Shultz succinctly summarized security assistance as follows:

> Security assistance serves a number of purposes: it helps allies and friendly countries to defend themselves and to deter threats of outside interference: it gives us influence to help mediate conflicts; it helps sustain our access to valuable bases in strategic areas; and it gives us the opportunity to promote the importance of respecting civilian government and human rights. Security assistance also enables allies and friends to accept

> defense responsibilities that we might otherwise have to assume ourselves--at much greater cost in funds and manpower. Dollar for dollar, it's the most cost effective security money can buy. (5:1-1)

In order to successfully attain its policy goals and objectives, the security assistance program employs seven major program components and FMS is one of them. FMS allows eligible foreign governments to purchase defense articles and services from the Unites States. Congress does not have to appropriate funds for FMS program because all costs relevant to such sales will be paid by the purchasing government. Under FMS, defense articles, services and training may be provided by U.S. military departments from its stocks, or by procuring it from industry (5:2-8).

Thanks to the FMS stipulation, the Republic of China Air Force (ROCAF) has been able to acquire its major weapon systems and materials from U.S. sources. In fact, ROCAF relies very heavily on the FMS channel for its acquisition of defense articles and for the follow-on logistics support. Therefore, the importance of FMS to ROCAF can not be over-emphasized.

Currently, ROCAF submits an average of about 6,000 requisitions through the FMS channel as shown in the Military Standard Requisitioning and Issue Procedures (MILSTRIP) Transaction Submittal Report on a monthly basis (12). Further discussions about the requisition flow and material flow can be found in Chapter II.

Problem Statement

The ROCAF FMS distribution system has been in existence for many years. This system makes it possible for all FMS materials acquired from U.S. sources to go through various links in the channel to reach the end users. Although it is a system of necessity, it may not necessarily be a system of effectiveness. In the past years, ROCAF has experienced great difficulties in finding urgently needed items to support broken equipment or grounded aircraft. In many cases, such items have been shipped from supply sources for quite a while and some of them have actually been delivered to Taiwan as well. However, it is sometimes nearly impossible to locate an item without taking strenuous efforts to trace it and find its correct bill of lading. When faced with this situation, how can ROCAF project its fighting forces where and when they are needed without the right parts for the right aircraft delivered to the right place at the right time (18:11). Can the ROCAF FMS distribution system be improved?

Justification of Research

There are several reasons for doing this research:

First, this FMS distribution channel plays a vital role in providing necessary logistics support to ROCAF units. It serves as the main artery in ROCAF's overall logistics

support system. Therefore, its importance can not be overlooked.

Second, although some problems have already surfaced in this system over the years, no research has taken a close look at it. As such, it is time to carefully examine this system to diagnose any problems which impair the smooth flow of materials through this essential ROCAF logistics network.

Third, the findings and recommendations as a result of this research may lead to the improvement of ROCAF FMS distribution system. Moreover, such findings and recommendations can be applied to the existing systems used by the Republic of China Army and Navy as well because these systems are quite similar. Other countries using similar channels may also benefit from this research.

Research Objective

The purposes of this study are:

1. To analyze the ROCAF FMS distribution system and to identify its problems and causes, whenever possible, and

2. To make recommendations based on the findings of this research.

Investigative Questions

The following questions will be examined and answered in order to achieve the objectives of this study. These questions are grouped under relevant headings.

Questions About the Flow Time from Supply Source to the Freight Forwarder.

1. How long does it take for an item to get to the freight forwarder located in New York when shipped from the supply source?

2. What is the average throughput time used by the east coast freight forwarder?

3. How long does it take for an item to get to the freight forwarder located in Los Angeles when shipped from the supply source?

4. What is the average throughput time required by the west coast freight forwarder?

Questions About Vessel's Travelling Time.

5. How long does it take for a vessel to travel from New York harbor to Los Angeles port?

6. How long does it take for an item to get to Keelung or Kaohsiung harbor when shipped from New York?

7. How long does it take for an item to get to Keelung or Kaohsiung harbor when shipped from Los Angeles?

Questions About Throughput Time at ROCAF's Transportation Stations.

8. What is the average throughput time required at Keelung Transportation Station?

9. What is the average throughput time required at Kaohsiung Transportation Station?

Questions About the Flow Time from Transportation Stations to End User.

10. How long does it take for an item to get to the user from Keelung?

11. How long does it take for an item to get to the user from Kaohsiung?

Questions About the Flow Time from Supply Source to Shipment by the Freight Forwarder.

12. How long does it take from an item's first shipment by the supply source to its second shipment by the freight forwarder in New York?

13. How long does it take from an item's first shipment by the supply source to its second shipment by the freight forwarder in Los Angeles?

Questions About the Flow Time from Supply Source to Port of Entry in Taiwan.

14. How long does it take for an item to get to Keelung or Kaohsiung harbor from supply source when routed through New York freight forwarder?

15. How long does it take for an item to get to Keelung or Kaohsiung harbor from supply source when routed through Los Angeles freight forwarder?

Questions About the Flow Time from the Port of Entry in Taiwan to End User.

16. What is the average time required from the day an item is received by Keelung Transportation Station till it is delivered to the end user?

17. What is the average time required from the day an item is received by Kaohsiung Transportation Station till it is delivered to the end user?

Questions About the Flow Time from Supply Source to End User.

18. What is the average time required for an item to reach the end user from its first shipping date if it is routed through New York?

19. What is the average time required for an item to reach the end user from its first shipping date if it is routed through Los Angeles?

20. How long does it take for an item to reach the end user when it is shipped by the supply source?

Question About Problems or Bottlenecks.

21. What are the problems or bottlenecks of this distribution system and what are their causes?

Scope and Limitations

Since this is a pilot study of the ROCAF FMS distribution system, the primary objectives are to find out whether there are any problems existing in the system and to

make recommendations based upon the findings, so there are some areas that will not be covered by this research.

Requisition Flow. Although the requisition lead time for some items is quite lengthy, the FMS customers usually have tc accept it as a given because this is something beyond their control. For this reason, the time an item spends in the requisition flow will not be explored by this research.

Instead, this research is interested in the material flow portion of the ROCAF FMS distribution system with an intention to identify the flow time an item has to spend in each link of this distribution channel and to detect any latent problems. For instance, if an excessive amount of time is required for an item to go through certain link, then it can be inferred that there must be something wrong at or near that link. If any problems are detected, their causes will be identified, if possible. It is also the intention of this research to find out the total pipeline time of the ROCAF FMS distribution system.

Note: The pipeline time in this research is defined as the total elapsed time between the date an item is shipped from the supply source till the date when it is received by the end user.

Materials Shipped by Air. Current contract signed by the Defense Procurement Division (DPD), Coordination Council for North American Affairs Division (CCNAA) in Washington, D.C. and the freight forwarder indicates that all priority

1-3 cargoes for air force will be shipped by air (6:A-3). The actual percentage of ROCAF FMS materials shipped by air can be found from the following sources:

1. According to the quarterly "Country Requisition Submission Statistics" of 1 October 1989 maintained by ILC/GBPN, among a total of 37721 open requisition numbers submitted by Taiwan, 576 were on priority 03. In other words, high priority items constituted only about 1.53 percent of total requisitions (12).

2. Based on the freight forwarder's monthly receiving and shipping report, the percentage of materials shipped by air versus those shipped by ocean vessel is about 2% and 98% respectively (11).

These data clearly indicate air shipment constitutes only a small portion of the total shipment of ROCAF FMS materials. Therefore, this research will focus on the materials shipped by ocean because it is the major mode of transportation. And items shipped by air will not be covered by this research. Future research might be able to further explore this area.

Materials Lost in Shipment. Any materials shipped from the sources of supply but are lost somewhere in the distribution system will not be of interest to this study because they are usually treated by the "Report of Discrepancy (ROD)" (5:16-5). The statistical data kept by ILC/ROD reveal that there is slightly over one percent (1%)

of RODs submitted against lost or discrepant materials delivered to all FMS countries. However, the actual figures should be somewhat higher than that because the current regulations specify that any RODs under one hundred (100) U.S. dollars will not be accepted. This regulation was written because experience shows the actual cost for processing a ROD is even more (2).

Summary

Chapter I has briefly introduced the FMS background, the problems faced by ROCAF, and the research questions. It has also defined the objectives, scope and limitations of this research. Chapter II will discuss the results of literature review and present some more information about ROCAF FMS distribution system.

II. Literature Review

Overview

Chapter II contains the literature review, elements of a basic international distribution channel, description of the ROCAF FMS distribution system, and definitions of some terms used in this research.

Review of Literature

The researcher has attempted to find relevant literature for this research from the following sources: the Air University Library Index to Military Periodicals (Air University, Maxwell AFB, AL), the Business Periodicals Index, the Reader's Guide to Periodical Literature and the data bases of the Defense Technical Information Center of the Defense Logistics Agency. However, these sources reveal that no research has been done on the ROCAF FMS distribution system. Since there is no existing literature available for review, the researcher first defined a basic international distribution channel, and then focused on the discussions of the ROCAF FMS distribution system to make it easier for the readers to follow.

Basic International Distribution Channel Defined

As shown in Figure 1 (5:17-7) and Figure 2 (16:Appendix H), FMS countries usually submit their requisitions through

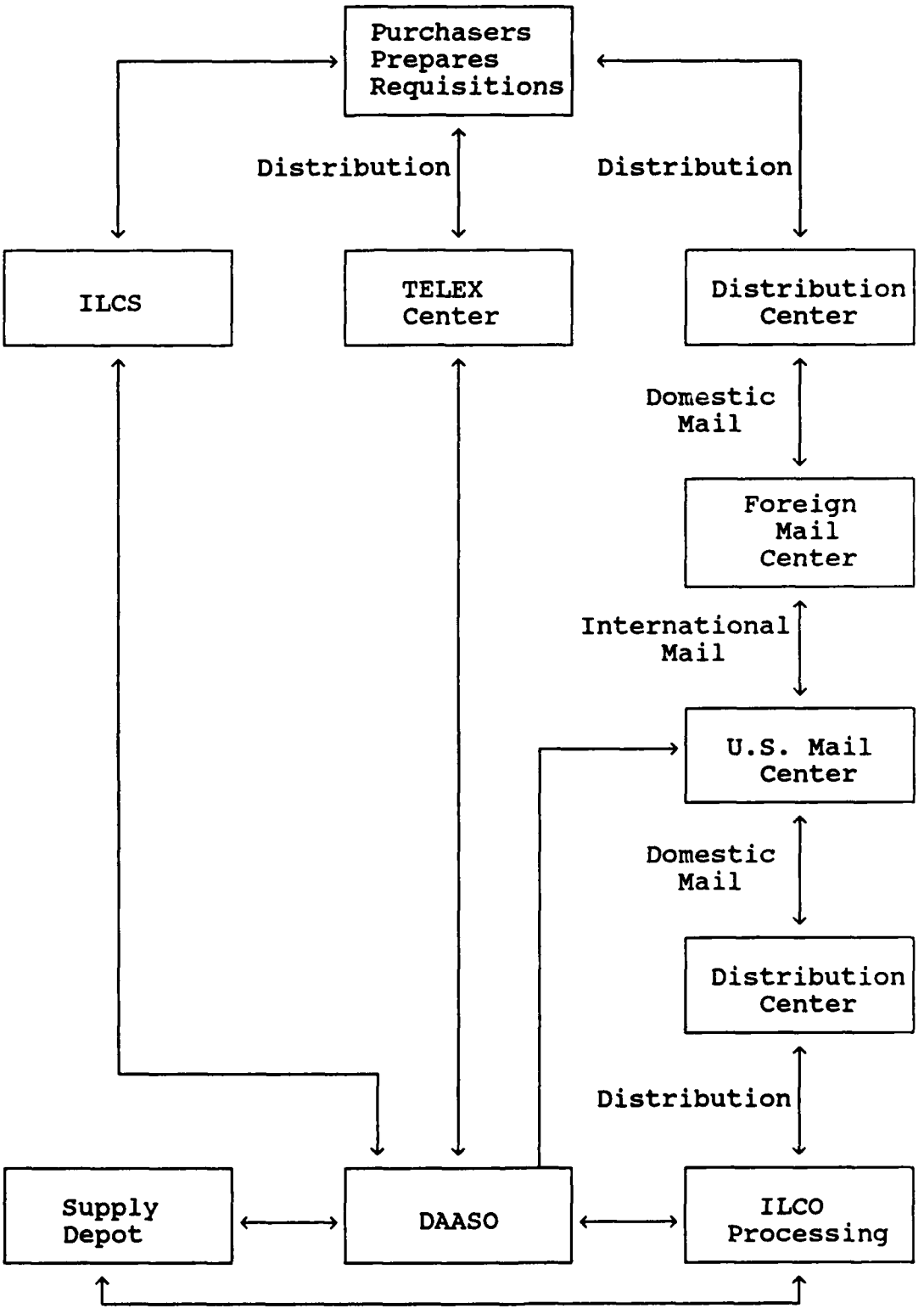

Figure 1. International Communication Channel

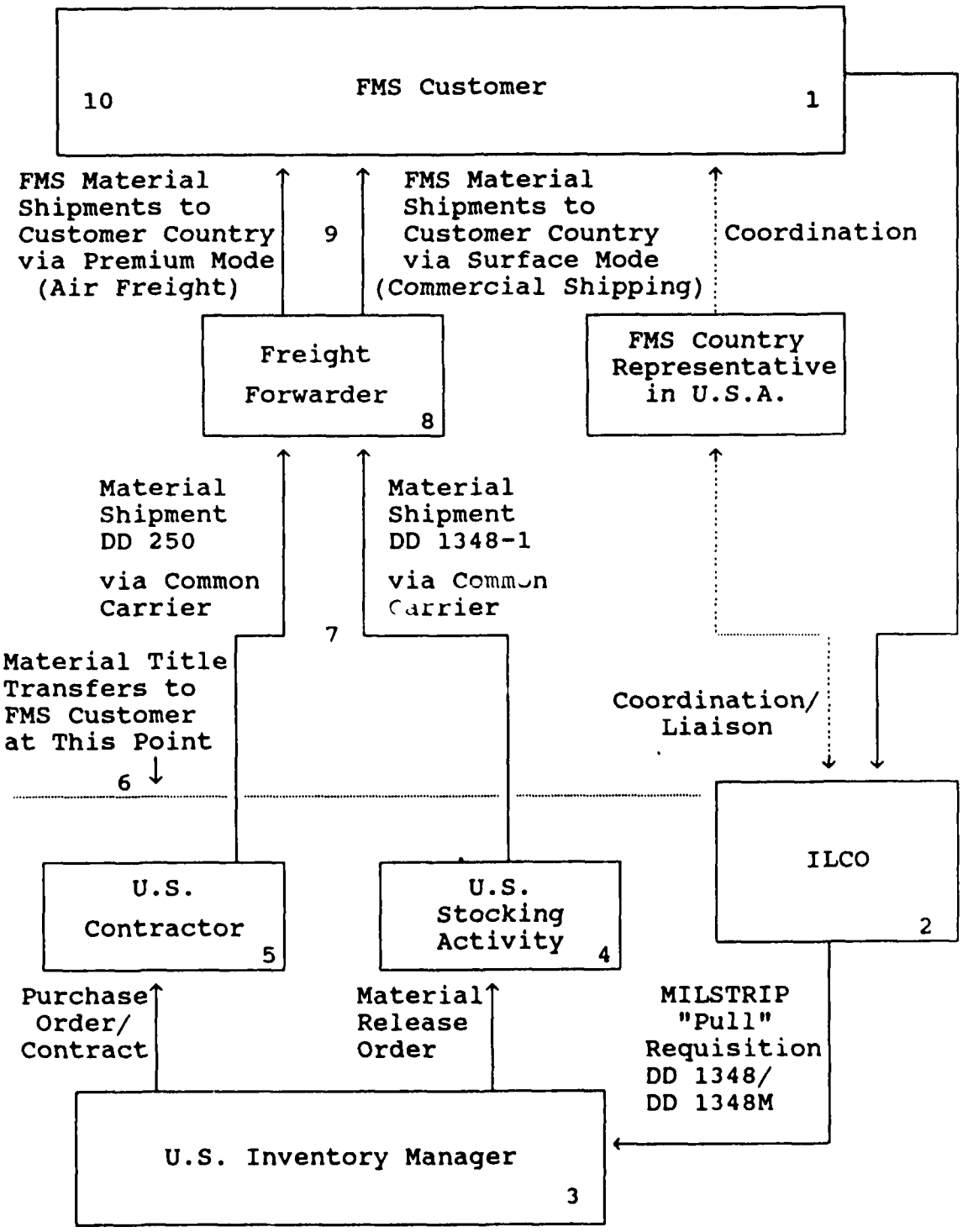

Figure 2. FMS Material Flow to Customer

mail, TELEX, or International Logistics Communication System (ILCS). Mail is too slow and only used by a few FMS customers. TELEX is mainly used by FMS countries with small amount of logistics transactions while ILCS is used by FMS customers with large volume of transactions. These requisitions are normally transmitted to Defense Automatic Addressing System Office (DAASO), Gentile Air Force Station, Dayton, Ohio. DASSO will then automatically route these requisition numbers to the appropriate International Logistics Control Office (ILCO) for processing. ILCO will verify the validity and proper funding of the requisitions and then forward them to the sources of supply, either directly or via DAASO (5:17-8).

FMS materials are usually issued from Department of Defense (DOD) activities or from DOD contractors' facilities depending on the type of materials and the stock level at DOD activities as shown in Figure 2, which illustrates materials flow to FMS customers.

ROCAF FMS Distribution System

Basically ROCAF FMS distribution system is very similar to the international distribution channel mentioned above. ROCAF's FMS materials are requisitioned and distributed through a similar channel which consists of various links as shown in Figure 3. Brief explanations of ROCAF FMS distribution system are as follows:

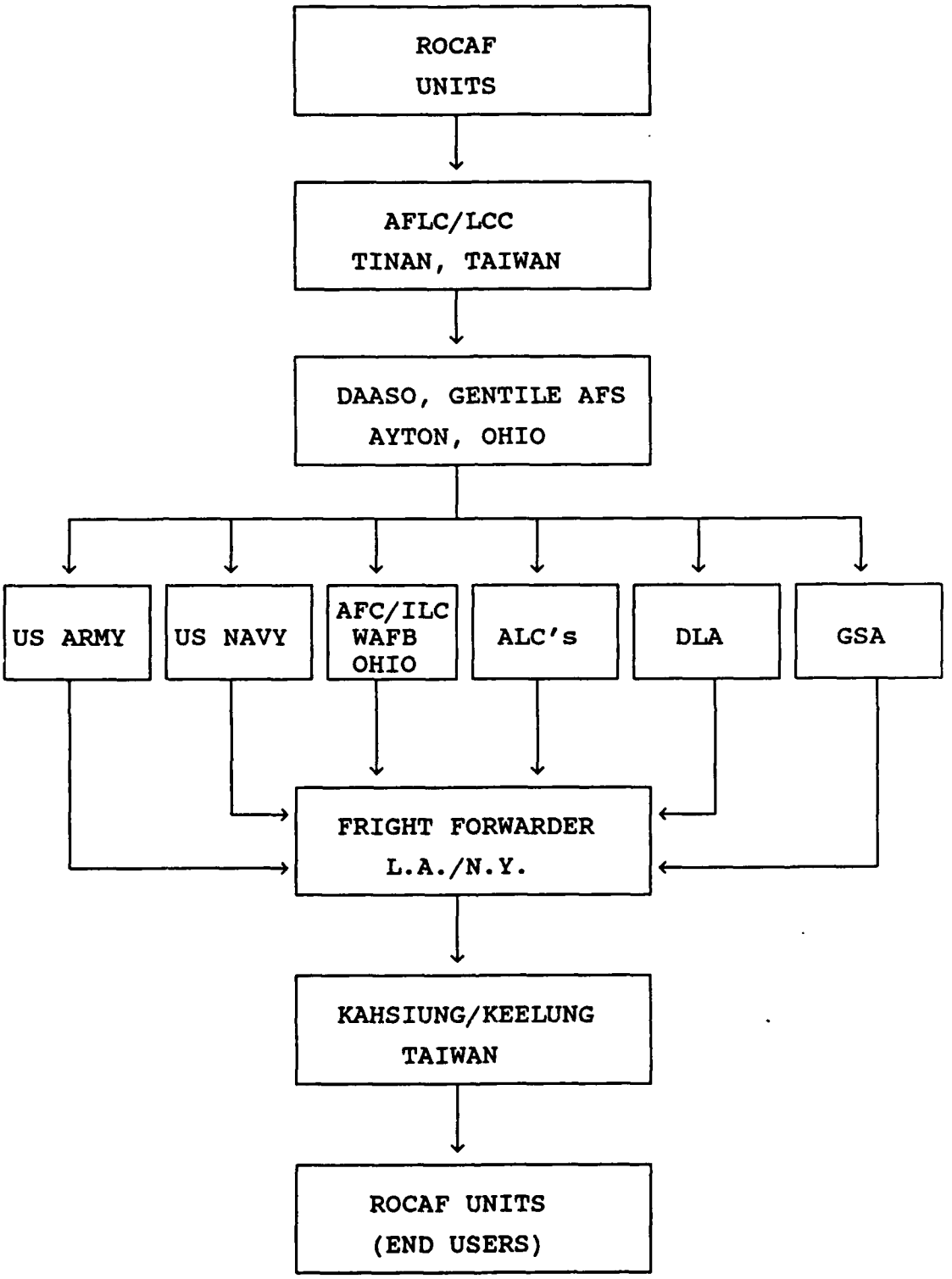

Figure 3. ROCAF FMS Distribution System

Requisition Flow. ROCAF Units submit their requisitions to Logistics Control Center (LCC) of Air Force Logistics Command (AFLC) located in Tainan. LCC then transmits these requisitions to DAASO, through ILCS (5:17-8). All document numbers received by DAASO will be automatically dispatched to such units as the International Logistics Center (ILC) of Air Force Logistics Command (AFLC) at Wright-Patterson Air Force Base (WPAFB), various Air Logistics Centers (ALC's), U.S. Army, U.S. Navy, Defense Logistics Agency (DLA) and General Services Administration (GSA) through Security Assistance Management Information System (SAMIS) for processing, depending upon which agency has responsibility for the requested item (5:17-10).

Material Flow. All FMS materials procured by ROCAF are usually shipped to ROCAF's freight forwarder either from U.S. military units or from their contractors' facilities. The freight forwarder has two offices and warehouses located separately in Los Angeles (L.A.), California and New York (N.Y.), New York to handle ROCAF's FMS materials. Usually, materials shipped from any supply sources located to the east of the Mississippi river will be directed to the east coast freight forwarder in New York while those shipped from anywhere west of the Mississippi river are to be routed to the west coast freight forwarder in Los Angeles. The materials handled by the east coast freight forwarder will be carried by a container ship which leaves New York harbor

and then goes to Los Angeles port to pick up the materials processed by the west coast freight forwarder.

The vessel will then depart Los Angeles port for Kaohsiung harbor in Southern Taiwan to unload cargoes designated for ROCAF units located to the south of Taichung, Taiwan. Thereafter, the vessel will head for Keelung harbor in Northern Taiwan to unload cargoes marked for ROCAF units located to the north of Taichung, including Taichung.

The two transportation stations located at Kaohsiung and Keelung harbors are responsible for receiving and reshipping the materials to ROCAF units within their respective geographic areas. The material flow comes to an end when items are delivered to the end users.

Freight Forwarder's Responsibility

The document which stipulates the freight forwarder's responsibilities and operating procedures is the contract signed between DPD, CCNAA and the freight forwarder. The contract establishes the responsibilities of the freight forwarder as follows:

> "Forwarder, for export shipment, arranges for inland freight, receives material, warehouses material, arranges shipments and delivers material to the pier or airport for delivery to the consignee in the Republic of China in a safe and timely manner and following the procedures set out in Exhibit 5." (6:A-1)

The basic functions of a freight forwarder can also be found under the Definition of Terms.

Definition of Terms

The following terms are used in this research and are defined as follows:

Foreign Military Sales (FMS). That portion of the United States security assistance authorized by the Foreign Assistance Act of 1961, as amended, and the Arms Export Control Act, as amended. This assistance differs from the Military Assistance Program and the International Military Education and Training Program in that the recipient provides reimbursement for defense articles and services transferred [JCS Pub 1]. FMS includes DOD cash sales from stocks (inventories, services, training); DOD guarantees covering financing by private or Federal Financing Bank sources for credit sales of defense articles and defense services; sales financed by appropriated direct credits; and sales funded by grants under the Military Assistance Program. (5:B-10)

Freight forwarders. A freight forwarder is normally a private firm under contract to the FMS customer to receive, consolidate, and stage material within the U.S. and arrange for its onward movement. As such, the freight forwarder's responsibilities are all contractually derived from the purchasing country and must be specified in the contract. Freight forwarders vary considerably in size, personnel manning and capability to process materiel, documents and data to the purchasing country. However, no matter the size of the freight forwarder or amount of materiel handled, all freight forwarders should attempt to accomplish the following basic functions:

1. Provide storage facilities and materiel handling equipment.
2. Have an in-transit visibility system.
3. Payment of collect commercial bills of lading (CCBL).
4. Immediate response to Notices of Availability (NOA).
5. Handling of shipment damage.
6. Repack, recrate, or reinforce containers.
7. Required marking, labeling and documentation.

8. Shipments of materiel in credit cases.

9. U.S. customs clearances.

10. Handling of returned reparables (5:20-6 to 20-8).

Military Standard Requisitioning and Issue Procedures (MILSTRIP). A uniform procedure established by the Department of Defense to govern requisition and issue of materiel within standardized priorities [JCS Pub 1] (3:B-16).

Not Mission Capable-Supply (NMCS). A condition of the item of equipment or a system, in the procession of the operational unit, indicating that it is not operationally ready and maintenance work can not be performed to return it to an operationally ready status until the required items of supply become available at the work site. (8:101)

Security Assistance (SA). Group of programs authorized by the Foreign Assistance Act of 1961, as amended, and the Arms Export Control Act, as amended, or other related statutes by which the United States provides defense articles, military training, and other defense related services, by grant, credit or cash sales, in furtherance of material policies and objectives [JCS Pub 1]. (5:B-19)

Note: Abbreviations are spelled out in this paper the first time they are used; however, for the reader's convenience, they are also listed in Appendix C.

Summary

Chapter II has presented the review of literature, defined a generic international distribution channel used for security assistance material, described the ROCAF FMS distribution system and the regulation governing the freight forwarder's responsibilities. The definition of key terms are also included. The methodology used for this research will be described in Chapter III.

III. Methodology

Overview

The purpose of this chapter is to describe the data sources, the data collection procedures and the methods that were used to analyze the data in order to answer the investigative questions in Chapter I.

Data Sources

The data were collected from the following sources:

1. The freight forwarder's monthly receiving-shipping report sent to the ROCAF Liaison Office located at WPAFB, Ohio.

2. USAF's SAMIS system.

3. Receiving-shipping records from the two transportation stations located at Keelung and Kaohsiung harbors, Taiwan.

4. Inventory records from FMS Branch, Logistics Control Center, AFLC, Tainan, Taiwan.

5. Vessel schedule of Yang Ming Marine Line from Solar International Shipping Agency Inc., New York, New York.

6. Interviews with USAF personnel working in ILC, WPAFB, Ohio.

7. Telephone interviews with Defense Procurement Division (DPD) representatives stationed at the freight forwarder's offices.

8. Telephone interviews with the fright forwarder's supervisors.

9. Telephone interviews with ROCAF personnel in Taiwan.

Data Collection

Sample Size. Based on the freight forwarder's monthly report, there were about 6,000 document numbers (or items) on average shipped from the west coast office and 1,000 shipped from the east coast office. Therefore, stratified samples were drawn from the freight forwarder's monthly receiving-shipping report in order to obtain more homogeneous samples and to achieve better statistical efficiency (9:306-309). The following formula was used for computing the maximum sample size needed from a known finite population to achieve a confidence level of 95%±5%:

$$n = \frac{N(z^2) \times p(1-p)}{(N-1)(d^2) + (z^2) \times p(1-p)}$$

where:

n = sample size
N = population size
p = maximum sample size factor (0.50)
d = desired tolerance (0.05)
z = factor of assurance (1.96) for 95% confidence level (7:11-14).

According to the above formula, the sample sizes required for this research should be 360 and 60 for items shipped from Los Angeles and New York respectively.

Procedures. The following procedures were used for collecting required samples and data:

Step 1: Four hundred and twenty (420) random samples of requisition numbers were drawn from the freight forwarder's monthly receiving and shipping report of January 27, 1989 (11:725-1376). These samples are included in Appendix A.

As shown in Appendix A, items (1) one through 360 were routed through the west coast freight forwarder in Los Angeles. That is why their bill of ladings all begin with LOS, which stands for Los Angeles. Among the 360 document numbers, the first 210 items were shipped to Taiwan through the southern port of entry--Kaohsiung. So their bill of ladings all contain the same designator--LOSKAO. In this case, KAO represents Kaohsiung. Items 211 through 360 (a total of 150) were routed through the northern port of entry in Taiwan--Keelung. For this reason, their bill of ladings also have a different designator, LOSKEE. Here, KEE means Keelung.

The last 60 samples (items 361 through 420) were shipped to the east coast freight forwarder in New York. Therefore, their bill of ladings all begin with NYC, which means New York. Among the 60 samples, 38 went to Kaohsiung. So their bill of ladings reveal the designator for port of arrival, NYCKAO. The remaining 22 of the 60 samples were shipped to Keelung. As such, their bill of ladings bear such designator as NYCKEE.

This first step allowed the researcher to obtain the sample requisition numbers with such information as FMS case, date received (R1) and date shipped (S2) by the freight forwarder, vessel name and the bill of lading. These two dates were then converted to Julian dates for consistence with the information to be found in SAMIS system. The difference between these two dates was the throughput time (R1-S2) used by the freight forwarder.

Step 2: The sample document numbers obtained in step 1 were used to interrogate SAMIS system. Code 165D was used to access both the SUMMARY and DETAIL information of each individual requisition number in SAMIS so as to find out the (Julian) date (S1) shipped by the supply source. The difference between this date and the date received by the freight forwarder was used to estimate the average time (S1-R1) an item needed to move from the supply source to the freight forwarder.

Step 3: Receiving-shipping records from Keelung and Kaohsiung transportation stations were used to identify the date received (R2) and date shipped (S3) for an item (10). The throughput time (R2-S3) needed by these two stations was derived from these records.

Step 4: Receiving date (R3) of an item by the end user were obtained from LCC located in Tainan, Taiwan (10).

Step 5: The average time an item needed to go through each of the various links in the distribution channel was

calculated from the data collected in steps 1 through 4. The total pipeline time of the ROCAF FMS distribution system was obtained by adding up the flow time in each link.

Data Analysis

Descriptive statistics were used to analyze all data collected in each step so as to obtain such information as frequency, mean, standard deviation, minimum and maximum values.

The statistical results contained in Chapter IV do reveal some problems or bottlenecks in the ROCAF FMS distribution system. These problems were further traced in order to determine their causes. For example, were they caused by manpower shortage, improper process or bad management? The findings from the data analysis can also be used to evaluate the freight forwarder's performance. For instance, "ocean shipment shall be shipped within ten (10) working days after receipt and air shipment shall be shipped within seven (7) working days" by the freight forwarder as specified in the contract signed between DPD, CCNAA and the freight forwarder (6:A-9). These data also provided sufficient evidence to show how well the freight forwarder was able to comply with the contractual articles.

Conclusions and recommendations were made based on the findings of data analysis, and discussed in Chapter V.

Summary

Chapter III has discussed the methodology used to collect and analyze data, including sources of data, sample size, procedures for data collection and data analysis. Chapter IV will present the analysis of data and findings of this research.

IV. Analysis of Data and Findings

Overview

As stated in Chapter I, the objective of this research is two fold. The first objective is to analyze the ROCAF FMS distribution system and to identify its problems and causes, if there are any. To meet this objective and to answer all investigative questions, collected data were analyzed using descriptive statistics and then summarized in various tables. Each table contains such key elements as flow time, sample size, frequency, percentage, cumulative percentage (Cumul. %), minimum (Min) value, maximum (Max) value, mean and standard deviation (Std Dev). The unit used for measuring the flow time an item spent in each link of the ROCAF FMS distribution channel is day(s).

As a result of data analysis, some problems are identified. The causes of these problems are also traced and described in this chapter.

Investigative Questions

There are twenty one (21) investigative questions grouped under relevant headings in this section. The first eleven questions examined each individual link of the ROCAF FMS distribution system in order to identify problems existed in the system. The last ten (10) questions evaluated at least two or more links at one time so as to provide the

flow time an item needed to go through certain links of this distribution system.

Questions About the Flow Time from Supply Source to the Freight Forwarder.

Investigative Question Number One. How long does it take for an item to get to the freight forwarder when shipped from the supply source?

Sixty (60) samples were used to analyze the flow time for items shipped to the freight forwarder in New York as shown in Table 1. The data in Table 1 are summarized as follows:

Table 1
Flow Time from Supply Source to N.Y. Forwarder

Day	Frequency	Percentage	Cumulative %
5	12	20.00%	20.00%
10	15	25.00%	45.00%
15	11	18.33%	63.33%
20	2	3.33%	66.67%
25	2	3.33%	70.00%
30	11	18.33%	88.33%
40	4	6.67%	95.00%
50	2	3.33%	98.33%
140	1	1.67%	100.00%
Total:	60	100.00%	100.00%

Descriptive Statistics

Min: 1 (Day)	Mean: 17.5
Max: 126	Std Dev: 18.28

1. Among all 60 items, 20% arrived at the freight forwarder within five (5) days.

2. Twenty five percent (25%) reached New York within 6-10 days; 18.33% arrived within 11-15 days. These constituted 63.33% of total shipment within 15 days (1/2 months).

3. An additional 6.6% were received within 16-25 days and 18.33%, within 25-30 days. This indicates that a total of 24.39% were received by the freight forwarder within 16-30 days. Total cumulative percentage was 88.33% within the first 30 days (one month).

4. Another 10% were received within 31-50 days. There was an item (1.67%) which spent 126 days to complete its first leg in the distribution channel. However, this was an outlier, a rare case rather than usual.

5. To sum up, the average time for an item to reach the east coast freight forwarder when shipped from the supply source was 17.5 days, with a standard deviation of 18.28 days .

Investigative Question Number Two. What is the average throughput time used by the east coast freight forwarder?

Table 2 summarizes the data for the throughput time needed by the freight forwarder in New York:

Table 2

Throughput Time Required at N.Y. Freight Forwarder

Day	Frequency	Percentage	Cumulative %
15	0	0	0
20	1	1.67%	1.67%
25	11	18.33%	20.00%
30	10	16.67%	36.67%
35	10	16.67%	53.33%
40	2	3.33%	56.67%
45	11	18.33%	75.00%
50	11	18.33%	93.33%
55	0	0	93.33%
60	4	6.67%	100.00%
65	0	0	100.00%
Total:	60	100.00%	100.00%

Descriptive Statistics

Min:	19 (Days)	Mean:	36.88
Max:	59	Std Dev:	11.11

1. Nothing was shipped out within 15 days (1/2 Months).

2. Only 20% of all items shipped to east coast freight forwarder were reshipped within 16-25 days while 16.67%, within 26-30 days. Cumulative percentage was 36.67% within 30 days (one month).

3. Twenty percent (20%) were reshipped within 31-40 days and 36.66%, within 41-50 days. The remaining 6.67% were received and reshipped within 51-60 days.

4. In summary, none of the items was shipped out within ten (10) working days (approximately two weeks) as specified by the contract signed between CCNAA and the freight forwarder (8:A-9). Over 43% of all items were

processed and shipped between 41-60 days. The average throughput time needed by New York freight forwarder was 36.88 days, with a standard deviation of 11.11 days.

Investigative Question Number Three. How long does it take for an item to get to the freight forwarder located in Los Angeles when shipped from the supply source?

All data relevant to this question are listed in Table 3 and summarized below:

Table 3

Flow Time from Supply Source to L.A. Forwarder

Day	Frequency	Percentage	Cumulative %
5	182	50.56%	50.56%
10	135	37.50%	88.06%
15	24	6.67%	94.72%
20	7	1.94%	96.67%
25	2	0.56%	97.22%
30	1	0.28%	97.50%
40	2	0.56%	98.06%
50	1	0.28%	98.33%
60	0	0	98.33%
70	2	0.56%	98.89%
80	0	0	98.89%
100	0	0	98.89%
120	1	0.28%	99.17%
140	1	0.28%	99.44%
160	0	0	99.44%
180	1	0.28%	99.72%
210	1	0.28%	100.00%
Total:	360	100.00%	100.00%

Descriptive Statistics

Min: 1 (Day)	Mean: 8.28
Max: 207	Std Dev: 17.09

1. As can be seen from Table 3, about one half (50.56%) of the materials were received by the Los Angeles freight forwarder within 5 days and an additional 37.5%, within 5-10 days. Their cumulative percentage reached 88.06% within ten (10) days.

2. Another 6.67% were received within 11-15 days. This means almost 95% of materials were received within 15 days (about two weeks).

3. The remaining 5.28% were received at different times, ranging from 16 to 210 days. These represent some problems in the distribution channel. However, their causes are not readily apparent.

4. To sum up, it took 8.28 days on average for an item to get to the west coast freight forwarder when shipped by the supply source. It also had a high value of standard deviation (17.09) days, so the variation could be high.

Investigative Question Number Four. What is the average throughput time required by the west coast freight forwarder?

Table 4 shows the throughput time needed by the freight forwarder located in Los Angeles. It contains the following key points:

1. None of the materials was shipped out within five (5) days and only 2.22%, within 6-10 days. An additional 17.5% were reshipped within 11-15 days. This indicated that

a total of less than 20% items were received and reshipped within 15 days (about 10 working days), which is the time frame specified by the contract (4:A-9).

Table 4
Throughput Time Required by L.A. Freight Forwarder

Day	Frequency	Percentage	Cumulative %
5	0	0	0
10	8	2.22%	2.22%
15	63	17.50%	19.72%
20	97	26.94%	46.67%
25	157	43.61%	90.28%
30	20	5.56%	95.83%
35	14	3.89%	99.72%
40	0	0	99.72%
45	1	0.28%	100.00%
Total:	360	100.00%	100.00%

Descriptive Statistics

Min:	8 (Days)	Mean:	20.15
Max:	45	Std Dev:	5.21

2. About 27% of materials were shipped within 16-20 days while 43.61%, within 21-25 days. In other words, over 90% of items were shipped up to this point.

3. An additional 5.56% of materials were shipped within 26-30 days and 3.89%, within 31-35 days. Only one item (0.28%) spent 45 days at the freight forwarder before it was shipped out.

4. In summary, the west coast freight forwarder needed an average throughput time of 20.15 days, with a standard deviation of 5.2 days.

Questions About Vessel's Travelling Time.

Investigative Question Number Five. How long does it take for a vessel to travel from New York harbor to Los Angeles port?

Appendix B lists sixteen (16) schedule samples of Yang Ming vessels with such information as name of vessel, voyage number, estimated time of departure from New York and Los Angeles ports and estimated time of arrival at Kaohsiung and Keelung harbors (20). Descriptive statistical results of Appendix B are contained in Table 5.

Table 5

Time Required for a Vessel to Travel from N.Y. to L.A.

Day	Frequency	Percentage	Cumulative %
13	0	0	0
14	7	43.75%	43.75%
15	1	6.25%	50.00%
16	0	0	50.00%
17	7	43.75%	93.75%
18	1	6.25%	100.00%
Total:	16	100.00%	100.00%

Descriptive Statistics

Min:	14 (Days)	Mean:	15.63
Max:	18	Std Dev:	1.54

As shown in Table 5, it took 15.63 days on average for a vessel to reach Los Angeles port after leaving New York Harbor. This means that all items routed through New York freight forwarder need an additional two weeks or even longer time to get to Los Angeles port. ROCAF can not do very much about the necessary time a vessel needs to sail across the ocean from east to west coast of the United States.

Investigative Question Number Six. How long does it take for an item to get to Keelung or Kaohsiung harbor when shipped from New York?

The shipment from New York to Keelung and the shipment from New York to Kaohsiung were examined separately in order to find out whether there was great difference between these two sets of data.

Shipment from New York to Keelung. Table 6 shows the data of flow time from New York to Keelung harbor. The statistical results are as follows:

1. About 27% of items arrived at Keelung harbor within 43-45 days (about 1.5 months) when shipped from New York.

2. An additional 36.36% reached Keelung within 46-50 days. Up to this point, the cumulative shipment was only 63.64%.

Table 6
Time Required from N.Y. to Keelung Harbor

Day	Frequency	Percentage	Cumulative %
40	0	0	0
45	6	27.27%	27.27%
50	8	36.36%	63.64%
55	8	36.36%	100.00%
60	0	0	100.00%
Total:	22	100.00%	100.00%

Descriptive Statistics

Min:	43 (Days)	Mean:	48.73
Max:	53	Std Dev:	3.36

3. The remaining 36.36% made their way to Keelung within 51-55 days.

4. To sum up, it took an item 48.73 days (over 1.5 months) on average to travel from New York to Keelung harbor, with a standard deviation of 3.36 days.

Shipment from New York to Kaohsiung. Table 7 shows the time an item needed to reach Kaohsiung Harbor when shipped from New York.

1. Only 2.63% of materials reached Kaohsiung within 30 days (one month).

2. The majority (65.79%) of items arrived at Kaohsiung harbor within 31-35 days.

3. Another 10.53% spent 36-40 days to complete the trip.

Table 7 Time Required from N.Y. to Kaohsiung Harbor			
Day	Frequency	Percentage	Cumulative %
25	0	0	0
30	1	2.63%	2.63%
35	25	65.79%	68.42%
40	4	10.53%	78.95%
45	0	0	78.95%
50	8	21.05%	100.00%
55	0	0	100.00%
Total:	38	100.00%	100.00%
Descriptive Statistics			
Min: 26		Mean: 37.42	
Max: 48		Std Dev: 5.23	

4. It took 46-50 days for the remaining 21.05% of materials to get to Kaohsiung harbor.

5. In summary, an item needed 37.42 days on average to finish the trip between New York port and Kaohsiung harbor, with a standard of 5.23 days.

The flow time in this link of the ROCAF FMS distribution is governed primarily by the carrier's vessel schedule regardless of whether it is from New York to Keelung or Kaohsiung.

Investigative Question Number Seven. How long does it take for an item to get to Keelung or Kaohsiung when shipped from Los Angeles?

Again, the flow time from Los Angeles to Keelung and the shipment from Los Angeles to Kaohsiung were investigated separately.

Shipment from Los Angeles to Keelung. Sample size used for evaluating shipment from Los Angeles to Keelung harbor was 150, as shown in Table 8. The data for the flow time in Table 8 are summarized as follows :

1. Among all items shipped from Los Angeles to Keelung, 4% arrived within 17-20 days; 8% reached Keelung between 21-25 days; 5.33% got there within 26-30 days. In other wards, a total of 17.33% finished this leg of journey within 30 days (a month).

Table 8
Time Required from L.A. to Keelung Harbor

Day	Frequency	Percentage	Cumulative %
15	0	0	0
20	6	4.00%	4.00%
25	12	8.00%	12.00%
30	8	5.33%	17.33%
35	108	72.00%	89.33%
40	13	8.67%	98.00%
45	2	1.33%	99.33%
75	1	0.67%	100.00%
Total:	150	100.00%	100.00%

Descriptive Statistics

Min:	17 (Days)	Mean:	31.20
Max:	71	Std Dev:	5.22

2. The majority (72%) of materials spent 31-35 days (5 weeks) to complete this trip.

3. An additional 10% needed 36-45 days to end this overseas voyage. Only one item (0.67%) spent 71 days to travel from Los Angeles to Keelung.

4. To sum up, an item needed 31.2 days (a little over one month) on average to reach Keelung when shipped from Los Angeles.

Shipment from Los Angeles to Kaohsiung. As shown in Table 9, 210 samples were used to evaluate the shipment from Los Angeles freight forwarder to Kaohsiung harbor. These data are summarized as follows:

1. One item made the trip within 12 days, which was very unlikely. Further examination of the original data in Appendix A revealed that it was caused by an error in data entry at Kaohsiung transportation station. Actual value should be 25 days.

2. Only 1.43% of items arrived at Kaohsiung within 16-20 days. The majority (53.81%) of materials reached Kaohsiung within 21-25 days. Another 26.67% got there within 26-30 days. These added up to a total shipment of 82.38% within 30 days (a month).

3. The remaining 17.62% spent 31-35 days to make the trip. In summary, it took an item 26.38 days on average, with a standard deviation of 3.77 days, to travel from Los Angeles freight forwarder to Kaohsiung Harbor.

This was also the average time a vessel needs to complete the voyage between the two sea ports.

Table 9
Time Required from L.A. to Kaohsiung Harbor

Day	Frequency	Percentage	Cumulative %
10	0	0	0
15	1	0.48%	0.48%
20	3	1.43%	1.90%
25	113	53.81%	55.71%
30	56	26.67%	82.38%
35	37	17.62%	100.00%
Total:	210	100.00%	100.00%

Descriptive Statistics

Min:	12 (Days)	Mean:	26.38
Max:	35	Std Dev:	3.77

The average time in Table 8 and Table 9 differs less than five days, which represents a vessel's traveling time from Kaohsiung to Keelung.

The data in Table 10 were derived from the vessel schedule provided by the carrier as shown in Appendix B.

As can be seen in Table 10, it takes a vessel 4.44 days on average, with a standard deviation of 2.03 days, to make the trip. In comparison with the vessel's travelling time from Kaohsiung to Keelung found in Table 8 and Table 9, these values are very similar.

Table 10 Time Required from Kaohsiung to Keelung Harbor			
Day	Frequency	Percentage	Cumulative %
2	0	0	0
3	3	18.75%	18.75%
4	10	62.50%	81.25%
5	2	12.50%	93.75%
8	0	0	93.75%
12	1	6.25%	100.00%
Total:	16	100.00%	100.00%
Descriptive Statistics			
Min: 3 (Days)		Mean: 4.44	
Max: 12		Std Dev: 2.03	

Questions About Throughput Time at ROCAF's Transportation Stations.

Investigative Question Number Eight. What is the average throughput time required at Keelung Transportation Station?

The throughput time for materials arrived at Keelung from New York and the throughput time for items shipped from Los Angeles are scrutinized separately.

Throughput Time at Keelung for Items Shipped from N.Y.

Table 11a shows the throughput time needed by Keelung Transportation station when items were shipped from New York. These data are summarized below:

1. Among all items received by Keelung Transportation Station, 36.36% were shipped within one day.

Table 11
Throughput Time at Keelung Transportation Station

a. Items from New York

Day	Freq.	Percent.	Cumul.%
1	8	36.36%	36.36%
2	7	31.82%	68.18%
3	0	0	0
4	2	9.09%	72.27%
5	5	22.73%	100.00%
Total:	22	100.00%	100.00%

Descriptive Statistics

Min: 1 (Day)
Max: 5
Mean: 2.5
Std Dev: 1.59

b. Items from Los Angeles

Day	Freq.	Percent.	Cumul.%
1	29	19.33%	19.33%
2	50	33.33%	52.67%
3	30	20.00%	72.67%
4	33	22.00%	94.67%
5	8	5.33%	100.00%
Total:	150	100.00%	100.00%

Descriptive Statistics

Min: 1 (Day)
Max: 5
Mean: 2.61
Std Dev: 1.18

In other words, over one third (1/3) of them were reshipped within 24 hours.

2. Less than 32% were shipped on the second day. Cumulative shipment now added up to 68.18%.

3. About 9% of materials were shipped on the fourth day. This means total shipment reached 77.27% within four (4) days.

4. The remaining 22.73% were shipped on the fifth day.

5. To sum up, the average throughput time used by Keelung Transportation Station was 2.25 days, with a standard deviation of 1.59 days.

Throughput Time at Keelung for Items Shipped from L.A. When materials were shipped from Los Angeles, the throughput time needed by Keelung Transportation Station is shown in Table 11b. These data are summed up as follows:

1. About 20% were shipped on the first day and 33.33%, on the second day. Cumulative shipment reached 52.67% within two days.

2. Items shipped on the third day constituted 20% of the total shipment.

3. An additional 22% were shipped on the fourth day and the remaining 5.33%, the fifth day.

4. The average throughput needed by Keelung Transportation Station for items shipped from Los Angeles was 2.61 days, with a standard deviation of 1.18 days.

The data in Table 11a and Table 11b clearly indicate that there is no significant difference in the throughput time used by Keelung Transportation Station whether materials arrived from New York or Los Angeles.

Investigation Question Number Nine. What is the average throughput time required at Kaohsiung Transportation Station?

To analyze the throughput time needed for materials arrived from New York and that required for items shipped from Los Angeles, two sets of data are presented in Table 12a and Table 12b respectively.

Throughput Time at Kaohsiung for Items Shipped from N.Y. Table 12a shows the throughput needed by Kaohsiung Transportation Station when items were shipped from New York. The data in Table 12a are summarized as follows:

1. The earliest shipment occurred on the seventh day for less than 8% of materials.

2. An additional 10.53% were shipped on the eighth day and 13.16%, on the ninth day. So far, only 31.58 % of total materials were shipped within ten (10) days.

3. About 55% of all items were shipped on the eleventh and twelfth day. The majority of shipment occurred at this time and the materials shipped summed up to 86.84%

4. An additional 10.52% were shipped on the 13th and 14th day. To sum up, it took 14 days (2 weeks) to ship out 97.37% of items. The last shipment of one item was made on the seventeenth (17th) day.

5. In summary, the average throughput time needed by Kaohsiung Transportation Station was 10.76 days, with a standard deviation of 2.13 days, if items arrived from New York. This value is much higher than that found in table

11a (2.5 days). So it is safe to say that here lies one of the bottlenecks in the ROCAF FMS distribution system.

Table 12

Throughput Time at Kaohsiung Transportation Station

a. Items from New York				b. Items from Los Angeles			
Day	Freq.	Percent.	Cumul.%	Day	Freq.	Percent.	Cumul.%
6	0	0	0	2	2	0.95%	0.95%
7	3	7.89%	7.89%	4	5	2.38%	3.33%
8	4	10.53%	18.42%	5	11	5.24%	8.57%
9	5	13.16%	31.58%	6	17	8.10%	16.67%
10	0	0	31.58%	7	35	16.67%	33.33%
11	12	31.58%	63.16%	8	26	12.38%	45.71%
12	9	23.68%	86.84%	9	33	15.71%	61.43%
13	2	5.26%	92.11%	10	37	17.62%	79.05%
14	2	5.26%	97.37%	11	11	5.24%	84.29%
16	0	0	97.37%	12	19	9.05%	93.33%
18	1	2.63%	100.00%	13	6	2.86%	96.19%
				14	5	2.38%	98.57%
				16	1	0.48%	99.05%
				18	2	0.95%	100.00%
Total:	38	100.00%	100.00%	Total:	210	100.00%	100.00%

Descriptive Statistics

Min:	7 (Days)	Min:	1 (Day)
Max:	17	Max:	18
Mean:	10.76	Mean:	8.80
Std Dev:	2.13	Std Dev:	2.56

Throughput Time at Kaohsiung for Items Shipped from L.A. Table 12b shows the throughput time used by Kaohsiung Transportation Station when materials arrived from Los Angeles. These data are summarized as follows:

1. Less than 1% of materials was shipped within two (2) days.

2. About 17% were shipped within six (6) days.

3. The majority (62.38%) of the shipment occurred within 7-10 days. Up to this point, 79.05% were shipped within ten (10) days.

4. Over 14% were shipped within 11-12 days while the remaining 6.67%, within 13-18 days.

5. To sum up, the throughput time at Kaohsiung Transportation Station averaged 8.8 days, with a standard deviation of 2.56 days, if items were shipped from Los Angeles.

Questions About the Flow Time from Transportation Stations to End User.

Investigative Question Number Ten. How long does it take for an item to get to the user from Keelung?

Two different data sets were used to evaluate the flow time from Keelung Transportation Station to the users. Table 13a contains the first set of data for items received from New York while Table 13b lists the second set of data for materials shipped from Los Angeles freight forwarder.

Flow Time from Keelung to User for Items Shipped from N.Y. Table 13a shows the shipment from Keelung Transportation Station to the end users for items received from New York. These data are discussed as follows:

1. Less than 5% of materials reached the users within six (6) days (the first week).

Table 13
Flow Time from Keelung to End User

a. Items from New York

Day	Freq.	Percent.	Cumul.%
4	1	4.55%	4.55%
6	0	0	4.55%
8	3	13.64%	18.18%
10	2	9.09%	27.27%
12	5	22.73%	50.00%
14	1	4.55%	54.55%
16	1	4.55%	59.09%
20	3	13.64%	72.73%
25	3	13.64%	86.36%
30	3	13.64%	100.00%
Total:	22	100.00%	100.00%

b. Items from Los Angeles

Day	Freq.	Percent.	Cumul.%
4	2	1.33%	1.33%
6	1	0.67%	2.00%
8	28	18.67%	20.67%
10	32	21.33%	42.00%
12	19	12.67%	54.67%
14	23	15.33%	70.00%
16	9	6.00%	76.00%
20	8	5.33%	81.33%
25	5	3.33%	84.67%
30	15	10.00%	94.67%
35	1	0.67%	95.33%
40	1	0.67%	96.00%
50	4	2.67%	96.67%
60	0	0	96.67%
70	2	1.33%	100.00%
Total:	150	100.00%	100.00%

Descriptive Statistics

Min:	4 (Days)
Max:	29
Mean:	15.45
Std Dev:	7.37

Min:	3 (Days)
Max:	66
Mean:	14.83
Std Dev:	9.84

2. One half (50%) were received by the users within 7-14 days. This means one half of the materials were delivered to the users in the second week.

3. Around 18% were received by the user within 15-20 days (the third week).

4. The remaining 27.27% of materials arrived at their final destinations within 21-30 days (the fourth week).

5. To sum up, it took an average of 15.45 days (over two weeks) for an item to travel from Keelung Transportation Station to the end user, if items came from New York. This is an area that leaves some room for future improvement.

Flow Time from Keelung to User for Items Shipped from L.A. The flow time for materials coming from Los Angeles and shipped by Keelung Transportation Station to the end users is shown in Table 13b, which is summed up as follows:

1. Only 2% of materials reached the users within 6 days (the first week).

2. Forty (40%) of materials were received by the users within 7-10 days and another 28%, within 11-14 days. This indicates that the majority (68%) of items reached the users in the second week, with total cumulative shipment summed up to 70%.

3. An additional 11.33% of materials were delivered within 15-20 days (the third week) and 13.33%, within 21-30 days (the fourth week).

4. About 4% of items reached the users within 31-50 days. The remaining 1.33% arrived at their final destinations within 61-70 days.

5. In summary, it took an item almost 15 days (over 2 weeks) on average, with a standard deviation of 9.84 days, to travel from Keelung Transportation Station to the end user.

Investigative Question Number Eleven. How long does it take for an item to get to the user from Kaohsiung?

Table 14 includes two sets of data for the flow time from Kaohsiung Transportation Station to the end users. Table 14a and Table 14b represent the flow time for materials shipped from New York and Los Angeles respectively.

Flow Time from Kaohsiung to User for Items Coming from N.Y. Table 14a shows the shipment from Kaohsiung Transportation Station to the end users for items received from New York. These data are summed up as follows:

1. About 5.3% of materials reached the end users within 6 days (the first week).

2. Over 18% of items were received by the users within 7-10 days and 31.58%, within 11-14 days. This means one half (50%) of the materials were delivered to the users within 7-14 days (the second week).

3. An additional 26.32% of items were received by the users within 15-20 days (the third week) and another

5.26%, within 21-30 days (the fourth week). Total delivery now summed up to 86.84% within 30 days (the first month).

Table 14

Flow Time from Kaohsiung to End User

a. Items from New York				b. Items from Los Angeles			
Day	Freq.	Percent.	Cumul.%	Day	Freq.	Percent.	Cumul.%
2	0	0	0	2	4	1.90%	1.90%
4	1	2.63%	2.63%	4	21	10.00%	11.90%
6	1	2.63%	5.26%	6	24	11.43%	23.33%
8	4	10.53%	15.79%	8	28	13.33%	36.67%
10	3	7.89%	23.68%	10	22	10.48%	47.14%
12	7	18.42%	42.11%	12	24	11.43%	58.57%
14	5	13.16%	55.26%	14	20	9.52%	68.10%
16	5	13.16%	68.42%	16	12	5.71%	73.81%
20	5	13.16%	81.58%	20	23	10.95%	84.76%
25	1	2.63%	84.21%	25	17	8.10%	92.86%
30	1	2.63%	86.84%	30	2	0.95%	93.81%
35	1	2.63%	89.47%	35	5	2.38%	96.19%
40	0	0	89.47%	40	1	0.48%	96.67%
50	1	2.63%	92.11%	50	3	1.43%	98.10%
60	0	0	92.11%	60	0	0	98.10%
70	1	2.63%	94.74%	70	2	0.95%	99.05%
80	0	0	94.74%	90	0	0	99.05%
90	1	2.63%	97.37%	110	0	0	99.05%
100	1	2.63%	100.00%	130	0	0	99.05%
120	0	0	100.00%	150	2	0.95%	100.00%
Total: 38		100.00%	100.00%	Total:210		100.00%	100.00%

Descriptive Statistics

Min: 3 (Days)	Min: 2 (Days)
Max: 92	Max: 141
Mean: 19.79	Mean: 14.22
Std Dev: 19.83	Std Dev: 15.42

4. About 5.3% reached the end users within 31-60 days (the second month) and an additional 5.26%, within

61-90 days (the third month). Cumulative delivery added up to 97.37% within 90 days.

5. The remaining 2.63% spent 92 days to get to the final destination.

6. In summary, it took an item 19.79 days on average, with a standard deviation of 19.83 days, to travel from Kaohsiung Transportation Station to the end user, if items were shipped from New York.

Flow Time from Kaohsiung to User for Items Coming from L.A. The flow time for materials arrived from Los Angeles and shipped to the users by Kaohsiung Transportation Station is shown in Table 14b, which is summarized as follows:

1. Less than 24% of items were delivered to the users within 6 days (the first week).

2. Around 24% were received by the users within 7-10 days and almost 21%, within 11-14 days. These constituted about 45% of total delivery within 7-14 days (the second week). Cumulative shipment summed up to 68.10% within 14 days (two weeks).

3. An additional 16.66% got to the end users within 15-20 days (the third week) and another 9.05%, within 21-30 days (the fourth week). So total delivery within 30 days (a month) was 93.81%.

4. Roughly 4.3% got to the end users within 31-60 days (the second month).

5. Less than 1% of materials arrived at their final destinations within 61-90 days (the third month) and within 120-150 days (the fifth month) respectively.

6. In summary, for materials shipped from Los Angeles and shipped to the end users by Kaohsiung Transportation Station, it took an average of 14.22 days, with a standard deviation of 15.42 days.

Questions About the Flow Time from Supply Source to Shipment by the Freight Forwarder.

Investigative Question Number Twelve. How long does it take from an item's first shipment by the supply source to its second shipment by the freight forwarder in New York?

So far, this research has examined each individual links of the ROCAF FMS distribution channel. From now on, the researcher intends to look at two or more links together in one time. For this reason, this investigative question takes into account the flow time of the first two links at the same time: i.e., the first link of the shipment from the supply sources to the east coast freight forwarder and the second link of processing time needed by the freight forwarder. The flow time for materials to go through these two links is contained in Table 15 and summarized as follows:

1. There was no second shipment made within 20 days after the materials left the supply sources.

Table 15
Time Required from Supply Source to Shipment from N.Y.

Day	Frequency	Percentage	Cumulative %
25	1	1.67%	1.67%
30	4	6.67%	8.33%
35	1	1.67%	10.00%
40	7	11.67%	21.67%
45	4	6.67%	28.33%
50	13	21.67%	50.00%
55	9	15.00%	65.00%
60	7	11.67%	76.67%
65	3	5.00%	81.67%
70	2	3.33%	85.00%
75	3	5.00%	90.00%
80	2	3.33%	93.33%
100	3	5.00%	98.33%
120	0	0	98.33%
180	0	0	98.33%
200	1	1.67%	100.00%
Total:	60	100.00%	100.00%

Descriptive Statistics

Min: 22 (Days)	Mean: 54.38
Max: 184	Std Dev: 22.29

2. There were 8.33% of materials reshipped within 21-30 days. This was also the total shipment made within the first 30 days (a month).

3. An additional 13.34% encountered their second shipment within 31-40 days and 6.67%, within 41-45 days. These summed up to 28.33% of cumulative shipment within 45 days (1.5 months).

4. Another 48.34% experienced their second shipment within 46-60 days. This means about one half of items were

reshipped within this time frame. Now the total shipment reached 76.67% within 60 days (two months).

5. Less than 14% were shipped from New York within 61-75 days. To sum up, 90% were shipped within 75 days (2.5 months).

6. About 8% left the freight forwarder within 76-100 days after their first shipment from the supply sources. Only one item spent 184 days on the land of continental United States. This was an unusual case caused by unknown reasons

7. In summary, an item needed an average of 54.38 days, with a standard deviation of 22.29 days, to complete its journey from the supply source till its shipment by the freight forwarder in New York. However, for all items shipped from New York, they need an additional 15.63 days on average to sail across the ocean to get to Los Angeles port as shown in Table 3. This can be considered as a flow time disadvantage if an item is critical to an aircraft in NMCS (Not Mission Capable-Supply) condition (6:101).

Investigation Question Number Thirteen. How long does it take from an item's first shipment by the supply source to its second shipment by the freight forwarder in Los Angeles?

Table 16 lists the data for the movement of materials in the continental United States from the supply sources to

the second shipment by the freight forwarder in Los Angeles. These data are summarized below:

1. No material was reshipped within 10 days after leaving supply source because the minimum value in Table 16 is 11 days.

2. Fifteen percent (15%) of materials left the freight forwarder within 11-20 days after first shipment from the supply source.

Table 16
Time Required from Supply Source to Shipment from L.A.

Day	Frequency	Percentage	Cumulative %
10	0	0	0
15	15	4.17%	4.17%
20	39	10.83%	15.00%
25	116	32.22%	47.22%
30	108	30.00%	77.22%
35	55	15.28%	92.50%
40	13	3.61%	96.11%
45	4	1.11%	97.22%
50	2	0.56%	97.78%
55	0	0	97.78%
60	1	0.28%	98.06%
70	1	0.28%	98.33%
80	1	0.28%	98.61%
90	1	0.28%	98.89%
115	0	0	98.89%
130	1	0.28%	99.17%
150	1	0.28%	99.44%
190	0	0	99.44%
220	1	0.28%	99.72%
240	1	0.28%	100.00%
Total:	360	100.00%	100.00%

Descriptive Statistics

Min: 11 (Days)	Mean: 28.44
Max: 240	Std Dev: 18.44

3. An additional 32.22% were reshipped within 21-25 days and 30%, within 26-30 days. These added up to the majority (62.22%) of items shipped within 21-30 days. And a total of 77.22% of materials already left the freight forwarder in Los Angeles within 30 days (one month).

4. Another 18.89% experienced their second shipment within 31-40 days. So far, the cumulative percentage summed up to 96.11%.

5. The remaining 3.89% left Los Angeles with wide spread time brackets, ranging from 41 to 240 days. These materials seemed to have encountered some problems. But their causes can not be determined immediately.

6. In summary, an item needed 28.44 days on average, with a standard deviation of 18.44 days, to depart the United States after leaving its supply source and being routed through Los Angeles. The total elapsed time was less than a month. Moreover, it is also less than one half of the time an item needs to travel from supply source to New York and then ferry across the ocean to reach Los Angeles.

Questions About the Flow Time from Supply Source to Port of Entry in Taiwan.

Investigative Question Number Fourteen. How long does it take for an item to get to Keelung or Kaohsiung harbor from supply source when routed through New York freight forwarder?

This question intends to look at three links (i.e., from the supply sources to the freight forwarder, from receipt to reshipment by the freight forwarder, and from shipment by the freight forwarder to receipt at either Keelung or Kaohsiung Transportation Station) at the same time and to provide answer to such question as how soon an item can be shipped overseas to Taiwan from the supply source. This information is useful for planning and forecasting purposes in the maintenance and supply areas. Table 17 contains such data. The following is a summary of those data:

1. The minimum time required for an item to go through the three links mentioned above was 65 days. Therefore, no material was delivered to Taiwan from the supply source within 60 days (two months) if it was routed through New York.

2. Less than 12% were received within 61-75 days (2-2.5 months).

3. An additional 33.33% arrived at either Keelung or Kaohsiung within 76-90 days (2.5-3 months), with cumulative shipment reached 45%.

4. Another 31.67% reached Taiwan within 91-105 days (3-3.5 months).

5. About 15% were delivered to the two transportations within 106-120 days (3.5-4 months). Cumulative shipment summed up to 91.67% within 120 days (4 months).

Table 17

Time Required from Supply Source Through N.Y. to Keelung/Kaohsiung

Day	Frequency	Percentage	Cumulative %
60	0	0	0
65	1	1.67%	1.67%
70	0	0	1.67%
75	6	10.00%	11.67%
80	6	10.00%	21.67%
85	11	18.33%	40.00%
90	3	5.00%	45.00%
95	7	11.67%	56.67%
100	4	6.67%	63.33%
105	8	13.33%	76.67%
110	4	6.67%	83.33%
115	4	6.67%	90.00%
120	1	1.67%	91.67%
135	3	5.00%	96.67%
150	1	1.67%	98.33%
165	0	0	98.33%
200	0	0	98.33%
220	1	1.67%	100.00%
Total:	60	100.00%	100.00%

Descriptive Statistics

Min: 65	Mean: 95.95
Max: 219	Std Dev: 22.26

6. Almost 7% needed 121-150 days (4-5 months) to finish the overseas journey.

7. The remaining 1.67% spent 219 days to get to Taiwan. This was a rare case.

8. To sum up, the total flow time an item needed from the supply source, through New York, to either Keelung or Kaohsiung averaged 95.95 days (over 3 months), with a standard deviation of 22.26 days.

Investigative Question Number Fifteen. How long does it take for an item to get to Keelung or Kaohsiung harbor from supply source when routed through Los Angeles freight forwarder?

Table 18 provides the data for the movement of materials from the supply source to the freight forwarder in Los Angeles, and then from there to Keelung or Kaohsiung in Taiwan. These data are summarized as follows:

1. As can be seen from Table 18, only 1.39% of materials was delivered to the ports of entry in Taiwan within 40 days after being shipped by the supply source and routed through Los Angeles. Cumulative shipment was only 8.06% within 45 days (1.5 months).

2. About 19% were received by the two transportation Stations within 46-50 days and 53.61%, within 51-60 days. These constituted the lion share of total shipment. Up to this point, a total of 80.28% of items were delivered overseas within 60 days (two months). The movement of materials in this case was much better than that happened to those items routed through New York. In the latter case, no material was ever delivered to the FMS customer within 60 days.

3. Another 16.67% spent 61-75 days to complete the overseas trip, with cumulative shipment reached 96.94% within 75 days (2-2.5 months).

Table 18 Time Required from Supply Source Through L.A. to Keelung/Kaohsiung			
Day	Frequency	Percentage	Cumulative %
35	1	0.28%	0.28%
40	4	1.11%	1.39%
45	24	6.67%	8.06%
50	67	18.61%	26.67%
55	94	26.11%	52.78%
60	99	27.50%	80.28%
65	46	12.78%	93.06%
70	11	3.06%	96.11%
75	3	0.83%	96.94%
80	2	0.56%	97.50%
85	1	0.28%	97.78%
90	1	0.28%	98.06%
110	2	0.56%	98.61%
125	1	0.28%	98.89%
140	0	0	98.89%
160	1	0.28%	99.17%
180	1	0.28%	99.44%
240	0	0	99.44%
260	2	0.56%	100.00%
Total:	360	100.00%	100.00%
Descriptive Statistics			
Min: 34 (Days)		Mean: 56.82	
Max: 257		Std Dev: 18.54	

4. The remaining 3.06% of materials varied greatly in their delivery time, ranging from 76 to 260 days.

5. In summary, an item needed 56.82 days on average, with a standard deviation of 18.54 days, to travel from the supply source, through Los Angeles, to either Keelung or Kaohsiung harbor. So the average flow time here was less than two months. This is much faster than the flow time (96

days) for those materials routed through New York as discussed in Investigative Question Number Fourteen.

Questions About the Flow Time from the Port of Entry in Taiwan to End User.

Investigation Question Number Sixteen. What is the average time required from the day an item is received by Keelung Transportation Station till it is delivered to the end user?

This question intends to look at the movement of materials from the time of their arrival in Taiwan till they are delivered to the end users. In other others, the researcher is interested in finding out how soon an item can be delivered to the user once it gets to the northern port of entry in Taiwan. Such information can be very useful to the decision makers and extremely valuable to the end users in ROCAF, especially when the operational readiness rate of weapon systems are jeopardized by the shortage of certain parts. In this case, the supply time is of critical importance.

The flow time from materials' arrival at Keelung till their delivery to the end users is given in Table 19, which contains two sets of data: one for materials routed through New York, the other for those went through Los Angeles.

Materials Routed Through N.Y. and Keelung to User.

Table 19a shows the data for the flow time of materials from their receipt at Keelung till their receipt by the users. These data are summed up as follows:

1. The earliest delivery was made on the fifth (5th) day. And total delivery was 18.18% within 5-10 days.

Table 19
Time Required
from Receipt at Keelung till Delivery to End User

a. Items Received from N.Y.				b. Items Received from L.A.			
Day	Freq.	Percent.	Cumul.%	Day	Freq.	Percent.	Cumul.%
6	1	4.55%	4.55%	6	3	2.00%	2.00%
8	0	0	4.55%	8	1	0.67%	2.67%
10	3	13.64%	18.18%	10	23	15.33%	18.00%
12	6	27.27%	45.46%	12	26	17.33%	35.33%
14	1	4.55%	50.00%	14	29	19.33%	54.67%
16	0	0	50.00%	16	5	3.33%	58.00%
18	2	9.09%	59.09%	18	23	15.33%	73.33%
20	1	4.55%	63.64%	20	10	6.67%	80.00%
22	1	4.55%	68.18%	22	2	1.33%	81.33%
24	0	0	68.18%	24	1	0.67%	82.00%
26	1	4.55%	72.73%	26	0	0	82.00%
28	2	9.09%	81.82%	28	9	6.00%	88.00%
30	3	13.64%	95.45%	30	9	6.00%	94.00%
32	0	0	95.45%	35	1	0.67%	94.67%
34	1	4.55%	100.00%	40	1	0.67%	95.33%
				45	4	2.67%	98.00%
				50	1	0.67%	98.67%
				60	0	0	98.67%
				70	2	1.33%	100.00%
Total: 22		100.00%	100.00%	Total: 150		100.00%	100.00%

Descriptive Statistics

Min: 5 (Days)	Min: 5 (Days)
Max: 34	Max: 69
Mean: 17.96	Mean: 17.43
Std Dev: 8.31	Std Dev: 10.03

2. About 32% reached their final destinations in the ROCAF FMS distribution system within 11-14 days. So up to this point (or within two weeks), one half (50%) of materials were delivered to the end users.

3. Another 13.64% got to their users within 15-20 days (the third week).

4. An additional 31.83% arrived at the end users' facilities within 21-30 days. To sum up, 95.45% of materials were shipped to the end users within 30 days (a month).

5. The remaining one item (4.55%) spent 34 days to travel from Keelung harbor to its final destination.

6. In summary, it took an item 17.96 days on average (over two weeks) to move from its port of entry in Keelung to the end user.

Materials Routed through L.A. and Kaohsiung to User. Table 19b contains the data for the flow time of materials routed through Los Angeles and later on received and delivered to the end users by Keelung Transportation Station. These data are summarized as follows:

1. No items were delivered to the end users within four days because the earliest shipment was completed on the fifth day.

2. There were 18% of materials reached the end users within 5-10 days.

3. About 37% were received by the users within 11-14 days. In other words, a total of 54.67% of materials were delivered to the users within two weeks after these items reached the shores of Taiwan.

4. Another 25.33% were delivered within 15-20 days (the third week), with total cumulative shipment reached 80%.

5. An additional 14% arrived at their final destinations within 21-30 days. That means a total of 94% of items were shipped to the end users within 30 days (a month).

6. It took the remaining 6% of materials longer time to complete their final leg of the trip, ranging from 31 to 69 days.

7. In summary, for materials routed through Los Angeles to Keelung, it took 17.43 days on average, with a standard deviation of 10.03 days, to reach the end users after their arrival at the northern port of entry in Taiwan.

Investigative Question Number Seventeen. What is the average time required from the day an item is received by Kaohsiung Transportation Station till it is delivered to the end user?

All materials arrived at Kaohsiung Transportation Station were previously routed through either New York or Los Angeles freight forwarder. The movement of materials

routed through the freight forwarder's two different offices will be examined separately in order to find out whether this has any impact on the handling of these materials by the Kaohsiung Transportation Station.

Materials Routed Through N.Y. and Kaohsiung to User. Table 20a lists the data for the flow time of those materials that were routed through the freight forwarder's New York office and then received as well as delivered to the end users by Kaohsiung Transportation Station after these materials' arrival at the southern part of entry in Taiwan. Summary of these data is as follows:

1. Since the earliest delivery was made on the 11th day, so there was no actual shipment within 10 days.

2. Only 2.63% reached the users within 11-14 days. In other words, the total delivery within the first two weeks was as low as 2.63%.

3. An additional 23.68% of materials were shipped to the users within 15-20 days (the third week).

4. The majority (52.62%) of items arrived at their final destinations within 21-30 days. And a total of 78.95% of items were delivered within 30 days (a month).

5. Another 13.15% were delivered within 31-60 days (the second month). Total delivery summed up to 92.11% within 60 days (two months).

Table 20
Time Required
from Receipt at Kaohsiung till Delivery to End User

a. Items Received from N.Y.				b. Items Received from L.A.			
Day	Freq.	Percent.	Cumul.%	Day	Freq.	Percent.	Cumul.%
12	1	2.63%	2.63%	8	1	0.48%	0.48%
14	0	0	2.63%	10	12	5.71%	6.19%
16	1	2.63%	5.26%	12	1	0.48%	6.67%
18	0	0	5.26%	14	28	13.33%	20.00%
20	8	21.05%	26.32%	16	21	10.00%	30.00%
22	2	5.26%	31.58%	18	32	15.24%	45.24%
24	0	0	31.58%	20	13	6.19%	51.43%
26	14	36.84%	68.42%	22	21	10.00%	61.43%
28	3	7.89%	76.32%	25	20	9.52%	70.95%
30	1	2.63%	78.95%	30	34	16.19%	87.14%
40	3	7.89%	86.84%	35	13	6.19%	93.33%
50	1	2.63%	89.47%	40	3	1.43%	94.76%
55	1	2.63%	92.11%	50	4	0.19%	96.67%
60	0	0	92.11%	60	3	1.43%	98.10%
80	1	2.63%	94.74%	80	2	0.95%	99.05%
90	0	0	94.74%	140	0	0	99.05%
100	2	5.26%	100.00%	160	2	0.95%	100.00%
Total:	38	100.00%	100.00%	Total:	210	100.00%	100.00%

Descriptive Statistics	
Min: 11 (Days)	Min: 8 (Days)
Max: 99	Max: 151
Mean: 30.55	Mean: 23.01
Std Dev: 19.24	Std Dev: 15.78

6. It took the remaining 7.89% much longer time to get to the users, ranging from 61 to 100 days.

7. In summary, the time an item needed to travel from its arrival at Kaohsiung harbor till it was received by the end user averaged 30.55 days, with a standard deviation of 19.24 days. In other words, it takes about a month for

an item to go through the last two links of ROCAF FMS distribution channel.

Materials Routed through L.A. and Kaohsiung to User. As to the materials that were previously routed through the freight forwarder's Los Angeles office, the data for the movement of those items from their arrival at Kaohsiung Transportation Station till they are received by the end users can be found in Table 20b. These data are summed up as below:

1. The earliest delivery to the end user was made within 8 days, but with very low percentage (0.48%). A cumulative total of only 6.19% were actually received by the users within 10 days.

2. About 14% reached their final destinations within 11-14 days. In other words, only 20% of materials were shipped to the users within 14 days (two weeks).

3. Another 31.43% were received by the users within 15-20 days and an additional 35.71%, within 21-30 days. To sum up, 87.14% of materials got to their users within 30 days (the first month).

4. More than 9% arrived at their final destinations within 31-60 days (the second month). And total cumulative shipment was 98.1% within 60 days (two months).

5. The remaining 1.9% spent much longer time, ranging from 61 to 151 days, in the last two links of the ROCAF FMS distribution channel.

6. In summary, an item needed an average of 23.01 days, with a standard deviation of 15.78 days, to go through Kaohsiung Transportation Station to its end user.

Questions About the Flow Time from Supply Source to End User.

Investigative Question Number Eighteen. What is the average time required for an item to reach the end user from its first shipping date if the item is routed through New York?

So far, this research has examined each individual link of the ROCAF FMS distribution system as discussed in investigative questions number one through eleven. It has also looked at several links together in one time as presented in investigative questions number twelve through seventeen. Nevertheless, these links have not been reviewed as a whole. The research will now consider the entire distribution channel as one.

The flow time for those materials shipped from the supply sources to the end users through the freight forwarder's office in New York and Taiwan's northern port of entry, Keelung, will be examined first and then followed by the flow time for those routed through Kaohsiung.

Shipment from supplier through N.Y. and Keelung to User. Table 21a shows the data of flow time for items shipped from the supply sources, through New York and Keelung, to the end users. These data can be described as follows:

1. As shown in Table 21a, the fastest delivery was made on the 88th days. And only 4.55% of materials reached the users within 90 days (three months).

2. About 32% were delivered within 91-105 days (3-3.5 months) and another 31.83%, within 106-120 days (3.5-4 months). To sum up, a total of 63.65% were delivered in the fourth month and these constituted the majority of materials delivered. Cumulative shipment reached 68.18% within 120 days (4 months).

3. An additional 9.1% made their way to the final destinations within 121-135 days (4-4.5 months) and 13.64%, within 136-150 days (4.5-5 months). So the total delivery in the fifth month was 22.74%. Cumulative shipment summed up to 90.91% within 150 days (5 months).

4. The remaining 9.1% were received by the users within 151-165 days (5-5.5 months).

5. To go through this channel, an item needed an average of 115.4 days, with a standard deviation of 20.1 days. This means it takes an item almost four (4) months to go through New York freight forwarder and Keelung

Transportation Station to get to the user once it is shipped by the supply source.

Table 21

Flow Time
from Supplier Through N.Y. and Keelung/Kaohsiung to User

a. Through N.Y. and Keelung

Day	Freq.	Percent.	Cumul.%
85	0	0	0
90	1	4.55%	4.55%
95	4	18.18%	22.73%
100	1	4.55%	27.27%
105	2	9.09%	36.36%
110	1	4.55%	40.91%
115	5	22.73%	63.64%
120	1	4.55%	68.18%
125	1	4.55%	72.73%
130	1	4.55%	77.27%
135	0	0	77.27%
140	3	13.64%	90.91%
145	0	0	90.91%
150	0	0	90.91%
155	1	4.55%	95.45%
160	0	0	95.45%
165	1	4.55%	100.00%
Total:	22	100.00%	100.00%

b. Through N.Y. and Kaohsiung

Day	Freq.	Percent.	Cumul.%
85	0	0	0
90	1	2.63%	2.63%
95	1	2.63%	5.26%
100	2	5.26%	10.53%
105	5	13.16%	23.68%
110	3	7.89%	31.58%
115	1	2.63%	34.21%
120	8	21.05%	55.26%
125	4	10.53%	65.79%
130	2	5.26%	71.05%
135	2	5.26%	76.32%
140	3	7.89%	84.21%
145	1	2.63%	86.84%
150	0	0	86.84%
165	1	2.63%	89.47%
180	1	2.63%	92.11%
210	2	5.26%	97.37%
230	0	0	97.37%
250	1	2.63%	100.00%
Total:	38	100.00%	100.00%

Descriptive Statistics

Min: 88 (Days)	Min: 88 (Days)
Max: 165	Max: 241
Mean: 115.4	Mean: 125.63
Std Dev: 20.1	Std Dev: 29.15

Shipment from Supplier through N.Y. and Kaohsiung to User. Table 21b contains the data of flow time for

materials shipped from the supply sources, and routed through New York and Kaohsiung, to the end users. These data are described as follows:

1. As shown in Table 21b, the earliest delivery occurred on the 88th day after the item was shipped from the supply source. In other words, only 2.63% were actually delivered to the users within 90 days (3 months).

2. About 21% reached their final destinations within 91-105 days (3-3.5 months) and 31.57%, within 106-120 days (3.5-4 months). This means a total of 52.62% were received by the users in the fourth month. Cumulative delivery now added up to 55.26% within 120 days (4 months).

3. An additional 21.05% made their way to the final destinations within 121-135 days (4-4.5 months) while 10.52%, within 136-150 days (4.5-5 months). That is to say, a total of 31.57% were delivered in the fifth month. And so far, 86.84% of materials were shipped to the users.

4. Another 5.26% arrived at their user's facilities within 151-180 days (5-6 months) while the remaining 7.89%, within 151-250 days (5 to over 8 months).

5. In summary, an item needed 125.63 days on average, with a standard deviation of 29.15 days, to go through this channel. That means the total flow time is more than four months.

Shipment from Supplier Through N. Y. and Keelung/Kaohsiung to User. Basically, if the only concern

is the flow time an item needs to travel from the supply source, through New York and either Keelung or Kaohsiung, to the end user, then Table 21a and Table 21b should be considered at the same time. In this case, the average flow time is 122 days, with a standard deviation of 26.7 days. So the flow time is still over four (4) months.

Investigative Question Number Nineteen. What is the average time required for an item to reach the end user from its first shipping date if the item is routed through Los Angeles?

This question intends to review the movement of materials from the supply sources, through the freight forwarder's Los Angeles office and Keelung/Kaohsiung, to the end users. The flow of materials from the supply sources to the end users, through the freight forwarder's Los Angeles office and Keelung, will be examined first, and then followed by discussions for those routed through Kaohsiung.

Shipment from Supplier through L.A. and Keelung to User. Table 22a shows the data for the movement of items through Los Angeles and Keelung to the users after being released from the supply sources. These data are discussed below:

1. As can be seen in Table 22a, only 3.33% of materials reached the users within 60 days. This means only a small portion of materials were actually delivered to the

users within 60 days (two months) after the suppliers shipped it.

Table 22

Flow Time from Supplier Through L.A. and Keelung/Kaohsiung to User

a. Items from New York				b. Items from Los Angeles			
Day	Freq.	Percent.	Cumul.%	Day	Freq.	Percent.	Cumul.%
50	0	0	0	50	1	0.48%	0.48%
55	1	0.67%	0.67%	55	2	0.95%	1.43%
60	4	2.67%	3.33%	60	7	3.33%	4.76%
65	15	10.00%	13.33%	65	33	15.71%	20.48%
70	41	27.33%	40.67%	70	43	20.48%	40.95%
75	32	21.33%	62.00%	75	36	17.14%	58.10%
80	28	18.67%	80.67%	80	26	12.38%	70.48%
85	11	7.33%	88.00%	85	22	10.48%	80.95%
90	5	3.33%	91.33%	90	17	8.10%	89.05%
95	4	2.67%	94.00%	95	5	2.38%	91.43%
100	2	1.33%	95.33%	100	1	0.48%	91.90%
110	3	2.00%	97.33%	110	7	3.33%	95.24%
120	0	0	97.33%	120	3	1.43%	96.67%
140	2	1.33%	98.67%	140	3	1.43%	98.10%
160	0	0	98.67%	180	0	0	98.10%
180	1	0.67%	99.33%	200	2	0.95%	99.05%
200	0	0	99.33%	220	1	0.48%	99.52%
250	0	0	99.33%	250	0	0	99.52%
270	1	0.67%	100.00%	270	1	0.48%	100.00%
Total:	150	100.00%	100.00%	Total:	210	100.00%	100.00%
Descriptive Statistics							
Min: 55 (Days) Max: 270 Mean: 76.34 Std Dev: 20.55				Min: 50 (Days) Max: 267 Mean: 78.35 Std Dev: 23.52			

2. About 59% were received by the users within 61-75 days (2-2.5 months) while 29.33%, within 76-90 days (2.5-3 months). To sum up, 88% of materials were delivered

in the third month, with a cumulative total of 91.33% arrived at their final destinations within 90 days (3 months) after leaving the supply sources.

3. An additional 6% were shipped to the users within 91-120 days (3-4 months).

4. The remaining 2.67% spent much longer time in the distribution channel, ranging from 121 to 270 days. These are some of the extreme cases.

5. In summary, the flow time an item needed from the supply source, through the freight forwarder's office in Los Angeles and Taiwan's northern port of entry, Keelung, to the end user averaged 76.34 days, with a standard deviation of 20.55 days.

Shipment from Supplier through L.A. and Kaohsiung to User. Table 22b lists the data of an item's flow time from the supply source, through Los Angeles and Taiwan's southern port of entry, Kaohsiung, to the users. These data are summarized as follows:

1. The earliest delivery was made on the 50th day. However, only 4.76% of materials reached the users within 60 days (two months).

2. About 54% were delivered within 61-75 days (2-2.5 months) and 30.96%, within 76-90 days (2.5-3 months). This means the majority (84.29%) of materials were shipped to the users in the third months. And altogether 89.05% of

items already made their way to the final destinations within 90 days (three months).

3. It took 91-120 days (3-4 months) for 7.62% of items to finish their long journey in the distribution channel. Cumulative shipment now summed up to 96.67% within 120 days (4 months).

4. Another 1.43% spent about 121-140 days to make the trip while the remaining 1.89%, 181-270 days (6-9 months). This flow time was too long and revealed that there were problem areas in the system.

5. In summary, for an item to go through Los Angeles and Kaohsiung to the end user when shipped from the supply source, it needs 78.35 days on average, with a standard deviation of 23.52 days. The average flow time is still over 2.5 months. However, it is 47.28 days (over 1.5 months) faster when compared with the flow time through New York and Kaohsiung as mentioned earlier and shown in Table 21b.

Shipment through L.A. and Keelung/Kaohsiung to User. If the port of entry in Taiwan is not of major concern, then Table 22a and Table 22b can be evaluated at the same time. Hence, the flow time for materials routed through Los Angeles and Keelung/Kaohsiung to the end users would be 77.5 days on average, with a standard deviation of 22.4 days. This flow time is similar to that shown in Table 22a and Table 22b. So there is no significant difference

among these three values. These data also reveal a uniform movement of materials though the freight forwarder's branch in Los Angeles and then to the ROCAF units regardless of which port of entry in Taiwan those materials actually go through.

Investigative Question Number Twenty. How long does it take for an item to reach the end user when it is shipped by the supply source?

This investigative question sums up the total pipeline time of the ROCAF FMS distribution system without considering whether materials have been routed through the freight forwarders branch in New York or Los Angeles in continental United States, nor the port of entry in Taiwan--Keelung or Kaohsiung. The statistical data for the total pipeline time are shown in Table 23 and summarized as follows:

1. The fastest delivery was made on the 50th day, but with negligible amount (0.24%). Cumulative shipment was only 3.57% within 60 days (two months).

2. An additional 47.62% of materials were received by the end users within 61-75 days (2-2.5 months). And 26.43%, within 76-90 days (2.5-3 months). In other words, almost two thirds (74.05%) of materials were delivered within 61-90 days (the third month). Total cumulative delivery reached 77.62% within 90 days (three months).

3. Another 14.05% arrived at their final destinations within 91-120 days (the fourth month). To sum up, 91.67% of

Table 23
Total Pipeline Time from Supply Source to End User

Day	Frequency	Percentage	Cumulative %
50	1	0.24%	0.24%
55	3	0.71%	0.95%
60	11	2.62%	3.57%
65	48	11.43%	15.00%
70	84	20.00%	35.00%
75	68	16.19%	51.19%
80	54	12.86%	64.05%
85	33	7.86%	71.90%
90	24	5.71%	77.62%
95	14	3.33%	80.95%
100	6	1.43%	82.38%
110	21	5.00%	87.38%
120	18	4.29%	91.67%
140	21	5.00%	96.67%
160	3	0.71%	97.38%
180	3	0.71%	98.10%
200	4	0.95%	99.05%
220	1	0.24%	99.29%
240	0	0	99.29%
250	1	0.24%	99.52%
270	2	0.48%	100.00%
Total:	420	100.00%	100.00%

Descriptive Statistics

Min:	50 (Days)	Mean:	83.85
Max:	270	Std Dev:	27.77

materials were delivered to the users within 120 days (four months).

4. The remaining 8.33% spent much longer time to go through the channel, ranging from 121 to 270 days.

5. In summary, the total pipeline time averaged 83.85 days, with a standard deviation 27.77 days (almost a month), which implies that the flow time has high variation.

This is a generalized question which provides the total flow time an item needs to travel from the supply source to its end user. The ROCAF personnel should find this information useful to their planning, forecasting as well as decision-making in logistics related matters.

Question About Problems or Bottlenecks.

Investigative Question Number Twenty-one. What are the problems or bottlenecks of this distribution system and what are their causes?

Based on the result of data analysis in the previous investigative questions, the material's average flow time in each link of the ROCAF FMS distribution system is presented in a flow chart and shown in Figure 4. By closely examining and comparing those relevant numbers, some areas that might have problems or bottlenecks are identified as follows:

1. The flow time from the sources of supply to the freight forwarder in New York was too long if compared with that to the freight forwarder in Los Angeles.

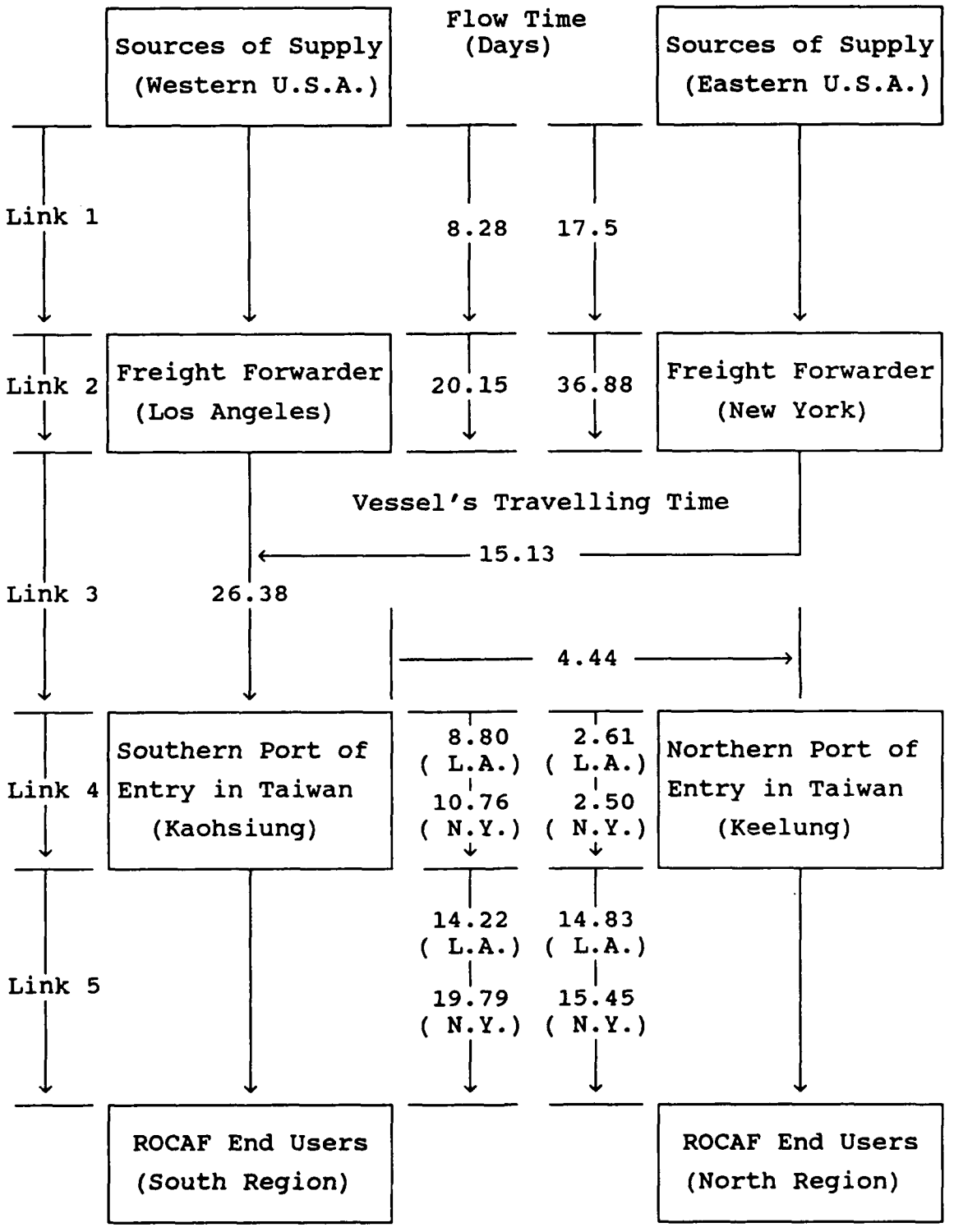

Figure 4. Flow Time of ROCAF FMS Distribution System

2. The throughput time at New York freight forwarder revealed that materials encountered a bottleneck here when compared with that needed by Los Angeles freight forwarder. Besides, it also far exceeded the the time limit (10 working days) spelled out in the contract signed between DPD, CCNAA and the freight forwarder.

3. Although materials could go through the west coast freight forwarder much faster, only a low percentage of materials could be shipped out within 10 working days which is the time frame dictated by the contract.

4. Kaohsiung Transportation Station was one of the bottlenecks in the distribution channel if its throughput time was compared with that used by Keelung Transportation Station.

5. The materials could not be moved very smoothly from the two transportation stations to the end users if judged by the flow time and the distance between the two transportation stations and the users. In fact, all ROCAF end users are within 200 kilometers (or 125 miles) from the transportation stations in their respective geographic regions.

These seemed to be the major problems or bottlenecks that have existed in the ROCAF FMS distribution system. Their causes will be further traced and discussed in the next section.

Problems and Causes

Flow Time from Sources of Supply to New York Freight Forwarder. It is difficult to identify any problems in the first link of this distribution channel by merely looking at the statistical data presented in Table 1 and discussed in Investigative Question Number One. However, if the average flow time (17.5 days) from the sources of supply to the New York freight forwarder is compared against that (8.28 days) to the Los Angeles freight forwarder as shown in Figure 4, it is apparent that the flow time in the former case is more than twice that of the latter. This clue triggered the author's interest to find out what has caused the difference between the two flow times. Here are some probable causes:

1. The materials are usually sent to the freight forwarder by UPS (United Parcel Service) and trucks depending on the weight and volume of each individual shipment. Sometimes, the carriers picked up the materials, but did not deliver it to the freight forwarder immediately (13). However, this was the minor cause of the problem.

2. The freight forwarder's New York office assigned only one person to receive the materials delivered to its warehouse. That person had to manually record all information in the forms. Sometimes, he was too busy to finish the job on the same day. This means some items were received earlier, but recorded as received later(13). That

is why the flow time in this link is much longer and it was also the major cause of the problem. Therefore, this was a problem caused by manpower shortage and bad management.

Throughput Time at East Coast Freight Forwarder. As mentioned in Investigative Question Number Two and shown in Table 2, no materials were shipped out by the New York freight Forwarder within 15 days (about 10 working days). So the freight forwarder in New York was unable to comply with the time frame set forth in the contract (6:A-9). In comparison, the throughput time for the New York freight forwarder averaged 36.88 days while that for the Los Angeles freight forwarder was only 20.15 days as listed in Figure 4. Their difference is more than two weeks. The researcher found out that the following causes have contributed to certain extent of the problem:

1. The carrier delivered the items to the freight forwarder without proper bill of lading in some cases. Sometimes, the quantity listed in the manifest did not match with the actual pieces delivered (13).

2. Some materials are shipped to the freight forwarder from the defense contractor's facilities. In this case, DD Form 250, Material Inspection and Receiving Report, will be attached to the items (16:42). For those materials delivered from Department of Defense (DOD) units, DD Form 1348-1, DOD Single Line Item Release/Receipt Document, is

the correct documentation to be furnished (16:39). However, some forms were received with incomplete information (13). In this case, the freight forwarder might have to find out such missing information as correct document number, national stock number (NSN), FMS case designator, priority, unit price and quantity in order to prepare the proper forms for customs clearance. Sometimes, the freight forwarder failed to find out relevant information and delayed the shipment. Therefore, shippers also contributed to some portion of the problem.

3. The supervisor at the warehouse and the manager in charge of CCNAA programs sometimes failed to resolve the problems immediately and let some problems to drag on for months without solutions. This also caused some delayed shipment (13). This can be categorized as management problem.

4. Materials received early and stored in the warehouse might not be shipped early because of bad management in the warehouse. In fact, some items came in first, but might go out last (13). This bad practice also contributed to delayed shipment and longer throughput time.

5. Since the materials handled by New York freight forwarder were much less than that processed by Los Angeles freight forwarder, sometimes there were not enough items to fill a full container. Under this circumstance, although materials were already loaded into container, they were not

shipped by the next available vessel because Yang Ming Line charged the freight rate by container and CCNAA thought it was not cost effective to pay full rate for a container loaded only to one third or one half of its capacity (13). This further aggravated the throughput time in New York.

Throughput Time at West Coast Freight Forwarder. As shown in Figure 4, although the throughput time at Los Angeles was 16.73 days less than that used by the freight forwarder in New York, only around 20% of materials were reshipped within 15 days (about 10 working days) as discussed in Investigative Question Number Four. This indicated that the freight forwarder in Los Angeles was not able to comply well with the contract either. Some causes for the lengthy throughput time are:

1. Because there were much more materials delivered to the freight forwarder in Los Angeles, it is, therefore, necessary for the freight forwarder to assign ten people to receive materials at the warehouse. However, the sheer quantity and volume delivered to the freight forwarder's warehouse still kept these people very busy. Sometimes, it took several days for them to manually consolidate small parcels into big boxes and put shipping labels or special markings on every package. They also had to manually record such information as date received, delivering carrier, numbers of pieces, quantity, national stock number, value,

weight and cube, transportation control number (TCN), requisition number, FMS case identifier, priority project code, shipper, inland freight charge, condition of packaging and material and warehouse location in the forms and then handed it over to the only person who was responsible for entering data into computer system. As such, it might take a few days to actually input the data of received materials into computer (4). This was a process related problem.

2. Incomplete information in the DD Forms mentioned earlier can also be applied to the Los Angeles freight forwarder (4).

3. Expired export licenses for certain FMS cases, dollar values exceeding a case ceiling or newly added items not listed in the original license sometimes also caused delayed shipment (4). However, the current contract says:

> Forwarder will establish a file for export licenses by expiration dates, and notify the Division in writing sixty (60) days before a license is scheduled to expire so that the Division or the supplier can apply for an extension or obtain a replacement license (6:A-4).

Therefore, this is also a problem caused by the freight forwarder's management.

Throughput Time at Kaohsiung Transportation Station.

As shown in Figure 4, Kaohsiung Transportation Station needed about six (6) to eight (8) more days than that required by Keelung Transportation Station to process

received materials. However, the researcher found out that ROCAF did not consider this as a problem for the following reasons (15):

1. All cargo containers that belong to the Republic of China Armed Forces are to be received at the pier by the representative of the Combined Service Forces (CSF) at first.

> Note: CSF is responsible for providing logistics support to the other armed branches, especially for items commonly used by them. CSF is the Chinese equivalent of American Defense Logistics Agency and General Services Administration combined together.

CSF representative will open the containers and then have each individual service's personnel physically inspect all the packages designated for that particular service and map out transportation plan to ship those items. This is when and where Keelung and Kaohsiung Transportation Station get involved in the receiving and reshipping activities. Their current operational procedures indicate that all items arrived at the port of entry shall be shipped within fifteen (15) days. In accordance with this regulation, the throughput time at Kaohsiung Transportation Station was still within the specified time limit, although it was six to eight days longer than that at Keelung Transportation Station.

2. Sometimes many containers arrived at the same time and could not be accepted and processed immediately. In

this case, the throughput time would be longer, but still within the 15-day limit.

Movement of Materials from Transportation Stations to User. The findings for the slow movement of materials are as follows:

1. All materials received by the two transportation stations were normally delivered to the prime depots within their respective geographic regions and stored in the warehouses until there was a demand from the end users. In this case, the flow time would be longer (15).

2. If materials delivered to the depots were already requisitioned by the end users, they would be issued soon because they were on back-order status. As such, the actual flow time of these items would be shorter than that for those mentioned in the above case (15).

3. Among all materials received by the transportation stations, there was an exception: all urgently needed items. In this case, they were delivered to the end users directly from the transportation stations if LCC gave such instructions. This was the fastest delivery and their flow time was also the shortest of these three cases (15).

For these reasons, the materials' flow time from the two transportation stations to the end users can be used for reference only. And it is almost impossible to quantify the actual flow time under these different cases because the

existing data maintained by LCC did not make any discriminations among these cases.

Summary

Chapter IV has analyzed all data collected for this research and examined the materials' flow time in each link of the ROCAF FMS distribution system. As a result of data analysis, the average flow time an item has to spend in one particular link or several links of this system can be found under the headings of related investigative questions. The total pipeline time has been determined as well. Moreover, some existing problems have been identified and their causes traced and discussed. So this chapter has achieved the first objective of the research. Based upon the findings in Chapter IV, some conclusions will be drawn and recommendations made in Chapter V so as to meet the second objective of this study.

V. Conclusions and Recommendations

Overview

Chapter V will provide the conclusions of this research at first. It will then address some solutions proposed by the researcher to solve the problems in the ROCAF FMS distribution system. Finally, some recommendations for future studies are also presented in this chapter.

Conclusions

The following conclusions are drawn based on the analysis of data and the findings of this research:

Source of Supply. As mentioned earlier, shippers also contributed to certain problems in delayed shipment by not providing the freight forwarder with complete information for the delivered items. However, since many of the shippers are contractors, the freight forwarder can not have much control over them. But the freight forwarder can always obtain needed information through DPD representatives or point of contact for sources of supply. Besides, the freight forwarder shall be responsible for obtaining additional information as specified in the contract:

> When DD Forms are not available, the Forwarder will contact the depot concerned to obtain additional forms. If unable to obtain DD Forms, the Forwarder will request permission from the Division to open boxes and locate the DD Form therein (6:A-16).

Freight Forwarder. As discussed in Investigative Questions Number One through Number Four and shown in Figure 4, the freight forwarder's Los Angeles branch was more efficient than its New York branch. However, both of them were not performing at a level of efficiency desired by the DPD, CCNAA as specified in the contract. The situation at the east coast freight forwarder was even worse. However, there are still some ways to improve their operations. Suggested solutions will be discussed later.

Vessel's Schedule. Based on the Yang Ming schedule listed in Appendix B and the freight forwarder's shipping record in the past, normally there are three vessels per month available for carrying ROCAF's FMS materials to Taiwan. However, due to fewer items delivered to the east coast freight forwarder, sometimes there was not enough cargo to fill a full container. Further studies should be made by ROCAF and DPD, CCNAA, in order to come up with a better solution. This will be further discussed under recommendations for future studies.

As to vessel's travelling time between the sea ports, it is mainly governed by Yang Ming Line's schedule. And there was no serious problems found in Investigative Questions Number Five through Seven. Furthermore, it is something that is beyond ROCAF's control.

ROCAF's Transportation Stations. From the discussions under Investigative Questions Number Eight and Nine and the data summarized in Figure 4, it can be concluded that the transportation station in Keelung was more efficient than the one in Kaohsiung. The average throughput time at Kaohsiung Transportation Station was significantly higher than that at Keelung Transportation Station. The difference between the two throughput times was as high as 6-8 days or roughly a week. This seems to be a good indication of which of the two transportation stations operates more effectively and efficiently.

The throughput time at Kaohsiung Transportation Station was still too long when compared to the situation in Keelung, even though it was within the 15-day limit set forth by ROCAF's existing operational procedures. Such rules or regulations should be changed if ROCAF desires faster movement of materials through this link.

Entire System. As a result of data analysis, some conclusions can be made about the ROCAF FMS distribution system:

1. It was neither effective nor efficient because materials could not move smoothly through the entire system without encountering some problems. That is why sometimes the materials were shipped by the sources of supply for quite some time, but the end users still did not receive

them. Therefore, timely supply of materials through this channel is not always possible. Besides, the length of pipeline time will also have some impact on ROCAF's inventory level, safety stock, and parts reorder cycle. Usually, the longer the pipeline time, the higher the quantity that has to be reordered each time (3:57).

2. The current system can not accurately and immediately identify the exact location of an item once that item gets into the system. That is why sometimes it was almost impossible to locate a critical item if ROCAF Liaison Office at WPAFB failed to find out that item's correct bill of lading. To improve its freight tracking capability, the system should be equipped with some kind of device which will serve that purpose. This will be discussed later under Suggested Solutions.

3. Given its existing problems, the discussions in Investigative Questions Number Eighteen through Twenty reveal that any item that goes through the freight forwarder in Los Angeles can be expected to reach the final destination 44.36 days, on average, faster than going through the freight forwarder's facility in New York. In comparison, the flow of materials from the supplier through Los Angeles and Keelung/Kaohsiung to the users seems to be a much preferable distribution channel than the one that goes through New York.

4. Great improvement in the overall efficiency and effectiveness of the ROCAF FMS distribution system can be achieved if the following suggested solutions are successfully implemented.

Implications of This Research. The results of this research can impact the parties listed below:

1. This research will provide invaluable contributions to ROCAF logisticians to enable them to better understand this distribution system and to make better decisions for their overall logistics support.

2. The Republic of China Army and Navy will also be benefited from this research because they are all using very similar systems.

3. The personnel of DPD, CCNAA can use this study as a reference to evaluate the freight forwarder's performance and to make proper decisions when it is time for them to renew the contract with the freight forwarder.

4. Even the freight forwarder's managers can gain some benefits from this study if they really care about securing future contract with DPD,CCNAA.

5. Finally, the other FMS countries can also gain some insights into this typical international distribution channel to better improve their own systems.

Suggested Solutions

Although the ROCAF FMS distribution system is plagued with several problems, some corrective measures can be taken to improve the movement of materials through the entire system. Based on the causes of problems found in Chapter IV, these problems could be categorized as process, manpower, management or equipment related. To successfully rid the system of these problems, the following possible solutions are proposed:

Bar Code Generator and Reader. The freight forwarder's two offices in New York and Los Angeles, ROCAF's two transportation stations in Keelung and Kaohsiung as well as ROCAF end users all had to manually register pertinent information of received items in forms. It is a very time-consuming job and prone to errors. Since materials shipped from DOD activities are attached with DD Form 1348-1 and the new Issue/Receipt Data Form (IRDF), which "is laser printed on perforated white bond paper and bar coded" (16:3), it is much faster and easier for the receiving unit to use a bar code reader (or scanner) to accurately read all information into their computer system. As to items shipped from contractor's facility, they are usually delivered with DD Form 250's, which are not bar coded. In this case, the receiving units can create their own bar coded forms by using bar code generator. This device will not only reduce

the flow time from the sources of supply to the freight forwarder in New York, but also dramatically shorten the throughput time at each receiving unit. Moreover, the accuracy of its information will far exceed that manually recorded by human beings. The same device and techniques can also be applied to items ready for shipment. Fewer people will be required as a result of using this state-of-the-art device. Therefore, the advantages of the bar code generator and reader can be many fold.

Enforcement of Contractual Articles. According to DPD's current contract with the freight forwarder, some of the contractual articles should be strongly enforced. The following are some of the examples:

1. From the telephone interviews with the freight forwarder's manager and CCNAA representative in Los Angeles, the researcher got the impression that they all interpreted the phrase "ocean shipment shall be shipped within ten (10) working days after receipt" (17) as loading the items into container, instead of actually ship them out, within 10 working days. This was a misinterpretation of the contractual article. It is recommended that the Contract Performance Section under Defense Procurement Division, CCNAA, in Washington, D.C. either revise this article to make it clearer or closely monitor the freight forwarder's performance and provide proper interpretation to ensure that

the freight forwarder has faithfully complied with this article.

2. Freight forwarder shall submit a report to DPD for unshipped items that have been received over 15 days with such detail information as document (TCN) number, warehouse number, source, carrier, priority, total value, receiving date and quantity (6:A-14 to A-15).

Based on the data listed in Table 2 and Table 4, delayed shipment was a serious problem . This implies that in the past neither the freight forwarder had faithfully complied with this article, nor had DPD personnel strongly enforced its fulfillment.

> 3. If the Forwarder fails to forward items which are classed as emergency items within a period of seven (7) working days for air shipment or ten (10) working days for ocean shipments, a penalty in the amount of $150.00 for each instance will be assessed (6:17).
>
> 4. If shipping information requested by the Division and/or end user as to the status of a shipment or charges is not supplied within five (5) working days after the request has been submitted, then a penalty of $150.00 for each instance will be imposed on the Forwarder (6:17).

In fact, only on rare occasions had the freight forwarder been fined by CCNAA representatives in the past years (13).

The throughput time at east and west coast freight forwarder's offices would decrease had the fulfillment of these articles been strongly enforced.

Installation of STARR/PC System. The readers may wonder what kind of system STARR/PC is. In fact, it is a new system developed by the Application Support Division of International Logistics Center in early 1989. Brief description of this system is as follows:

> STARR/PC (Supply Tracking and Reparable Return) is designed around a data download from SAMIS. On a daily basis SAMIS will produce a unique set of records that duplicate the current status of requisition in SAMIS. These records are then transmitted, via the International Logistics Communication System (ILCS) through the Defense Automatic Addressing System (DAAS) to the STARR/PC at the customer's location. These current records will replace the last set of records for the customer's requisitions. All processing of the MILSTRIP transactions is accomplished by SAMIS. STARR/PC merely updates its databases with the same status as found in SAMIS. This method eliminates the need for duplication of system logic between your software and SAMIS and the need for continuous updates to your software. (1:0.3)

STARR/PC is designed to run on personal computer (PC) used by an FMS customer's air force in country, its embassy in Washington, D.C., Foreign Liaison Office (FLO) at WPAFB, Ohio and the freight forwarder. There is a freight forwarder version that can be used by the freight forwarder "to input certain transactions reflecting receipts and shipments" of materials. In addition to these, STARR/PC will allow the customer to input all requisition numbers, changes and cancellations. It also enables the customer to access SAMIS data by using its query capability (1:0.3).

This is not a static system because it can be tailored to a customer's special needs. However, since STARR/PC is

developed for PC use, it will be unable to handle the large volume of transactions generated by ROCAF on a monthly basis. This means LCC can not use STARR/PC system as a substitute for its mainframe system while some FMS customers can use STARR/PC because they have much less requisitions. Nevertheless, ROCAF's Liaison Office at WPAFB Ohio, its freight forwarder's two branches, and its two transportation stations in Keelung as well as Kaohsiung can still use STARR/PC system for freight tracking purpose (14). Once the system is installed at such locations, it will provide a much better visibility of materials' whereabouts.

Recommendations for Future Studies

Since this research was a pilot study of the ROCAF FMS distribution system, its scope of research is limited. Future researchers might be able to further explore some areas that have not been covered by this study such as:

1. Cost/benefit study of the shipment of materials from those sources of supply located to the east of Mississippi river to the freight forwarder in New York as compared to the cost/benefit of shipping everything to the freight forwarder in Los Angeles. In the former case, it may save some inland transportation cost when shipping materials on the land of the United States. However, ROCAF still has to pay for the ocean shipment from New York to Los Angeles. Worse yet, it takes at least two more weeks for the vessel

to sail across the oceans to reach Los Angeles. As to the latter case, it costs more to move materials across the continental United States. But the time saved sometimes could mean much more than the money expended from the viewpoint of overall air force logistics support. Moreover, the shortened pipeline time will have far-reaching effect on ROCAF's stock level, inventory management, forecasting, planning and maintenance schedule as well as operational-readiness rate of aircraft and ground support equipment.

2. It is recommended that future studies also examine the amount of materials lost in the system and their impact on the operational readiness of affected weapon systems because "the loss of material in the distribution system has a double negative affect to" the ROCAF, the taxpayer and the government (19:186).

> First, a loss must be replaced through repurchase of the item. Replacement is an efficiency issue which can run into several million dollars per country and may very well come out of the taxpayer's pocket. Secondly, and more important from a national security viewpoint, loss of an item due to an ineffective distribution channel means a system may be out of commission until the item is found or until a replacement can be obtained. Loss of an item can have a debilitating effect on the readiness of (19:186) ROCAF.

3. Although the percentage of materials shipped by air was quite low, it is the fastest way to alleviate the NMCS conditions of aircraft and the other weapon systems. Therefore, it is recommended that future research also examine the cost and benefit of air shipment.

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
1	KBL	DTW44V705733958	88356	88364	89021	M-S	LOSKAOA2865	89053	89058	89069	8	23	32	5	11
2	KBL	DTW44V83004388	88328	88334	88348	M-M	LOSKAOA2557	89010	89017	89024	6	14	28	7	7
3	KBL	DTW44V83004391	88327	88335	88358	M-G	LOSKAOA2590	89013	89021	89027	8	23	21	8	6
4	KBL	DTW44V83004397	88328	88335	88358	M-G	LOSKAOA2594	89013	89021	89027	7	23	21	8	6
5	KBL	DTW44V83004399A	88332	88334	88348	M-M	LOSKAOA2557	89010	89017	89027	2	14	28	7	10
6	KBL	DTW44V83004401	88341	88343	88358	M-G	LOSKAOA2614	89017	89023	89025	2	15	25	6	2
7	KBL	DTW44V83004412	88317	88322	88338	M-F	LOSKAOA2543	88365	89009	89016	5	16	27	10	7
8	KBL	DTW44V83004433	88317	88322	88338	M-F	LOSKAOA2543	88365	89009	89016	5	16	27	10	7
9	KBL	DTW44V83004438A	88318	88322	88338	M-F	LOSKAOA2543	88365	89009	89017	4	16	27	10	8
10	KBL	DTW44V83013985	88336	88341	88358	M-G	LOSKAOA2617	89017	89023	89027	5	17	25	6	4
11	KBL	DTW44V83013995	88327	88333	88358	M-G	LOSKAOA2593	89017	89023	89027	6	25	25	6	4
12	KBL	DTW44V83014013	88320	88327	88348	M-M	LOSKAOA2557	89010	89017	89024	7	21	28	7	7
13	KBL	DTW44V83014018	88325	88336	88358	M-G	LOSKAOA2595	89017	89023	89027	11	22	25	6	4
14	KBL	DTW44V83014028	88344	88351	89010	M-L	LOSKAOA2653	89033	89044	89051	7	25	23	11	7
15	KBL	DTW44V83014037	88343	88348	89005	M-O	LOSKAOA2636	89030	89034	89045	5	23	25	4	11
16	KBL	DTW44V83014039	88320	88327	88348	M-M	LOSKAOA2557	89010	89017	89019	7	21	28	7	2
17	KBL	DTW44V830140428	88320	88326	88348	M-M	LOSKAOA2560	89010	89017	89019	6	22	28	7	2
18	KBL	DTW64V830037108	88328	88336	88358	M-G	LOSKAOA2595	89017	89025	89030	8	22	25	8	5
19	KBL	DTW74V83003458	88328	88347	88364	M-L	LOSKAOA3666	89033	89045	89059	19	17	35	12	14
20	KBL	DTW84V70563270A	88325	88334	88358	M-G	LOSKAOA2594	89017	89025	89044	9	24	25	8	19
21	KBM	DTW44V71774269	88153	88319	88364	M-L	LOSKAOA3666	89033	89044	89054	166	45	35	11	10
22	KBM	DTW44V83014065	88320	88326	88338	M-F	LOSKAOA2543	88365	89009	89028	6	12	27	10	19
23	KBM	DTW44V83014073	88321	88327	88358	M-G	LOSKAOA2592	89013	89021	89027	6	31	21	8	6
24	KBM	DTW44V83014113	88318	88323	88348	M-M	LOSKAOA2559	89010	89017	89028	5	25	28	7	11
25	KBM	DTW44V83014118	88318	88331	88348	M-M	LOSKAOA2560	89010	89017	89024	13	17	28	7	7
26	KBM	DTW74V82974001	88325	88333	88358	M-G	LOSKAOA2593	89017	89026	89045	8	25	25	9	19
27	KBM	DTW74V83003457	88349	88351	89005	M-O	LOSKAOA2634	89017	89026	89046	2	20	12	9	20
28	KBM	DTW74V83004091	88323	88327	88348	M-M	LOSKAOA2557	89010	89017	89031	4	21	28	7	14
29	KBM	DTW74V83004554	88325	88326	88348	M-M	LOSKAOA2560	89010	89017	89028	1	22	28	7	11
30	KBS	DTW44V83014099A	88314	88319	88338	M-F	LOSKAOA2545	88365	89009	89028	5	19	27	10	19
31	KBS	DTW64V60603747	88313	88334	88348	M-M	LOSKAOA2557	89010	89017	89023	21	14	28	7	6
32	KBS	DTW64V606135510	88350	88355	89010	M-L	LOSKAOA2654	89033	89045	89056	5	21	23	12	11
33	KCE	DTW74V62103002	88344	88354	89010	M-L	LOSKAOA2650	89033	89045	89056	10	22	23	12	11
34	KCE	DTW74V83544175	88363	89005	89030	M-U	LOSKAOA2715	89060	89069	89086	8	25	30	9	17
35	KCE	DTW64V33514267A	88337	88348	89005	M-O	LOSKAOA2634	89030	89044	89049	11	23	25	14	5
36	KCG	DTW44V829740088	88331	88342	88358	M-G	LOSKAOA2619	89017	89023	89027	11	16	25	6	4
37	KCG	DTW44V71773107	88313	88320	88338	M-F	LOSKAOA2545	88365	89009	89073	7	18	27	10	64
38	KCG	DTW44V829740088	88332	88337	88358	M-G	LOSKAOA2616	89017	89025	89049	5	21	25	8	24
39	KCG	DTW44V82974014	88336	88341	88358	M-G	LOSKAOA2618	89017	89025	89027	5	17	25	8	2
40	KCG	DTW44V82974189	88343	88348	89005	M-O	LOSKAOA2636	89030	89034	89048	5	23	25	4	15
41	KCG	DTW64V82974102	88339	88342	89010	M-L	LOSKAOA2650	89033	89034	89052	3	34	23	1	18
42	KCG	DTW64V829741138	88343	88347	88358	M-G	LOSKAOA2614	89017	89025	89031	4	11	25	8	6
43	KCG	DTW64V82974123	88335	88341	88358	M-G	LOSKAOA2618	89017	89025	89031	6	17	25	8	6
44	KCG	DTW74V82974061	88337	88344	88358	M-G	LOSKAOA2614	89017	89025	89034	7	14	25	8	9
45	KCG	DTW74V82974177	88345	88351	89010	M-L	LOSKAOA2653	89033	89035	89072	6	25	23	2	37
46	KCG	DTW74V82974218	88330	88337	88358	M-G	LOSKAOA2614	89017	89026	89051	7	21	25	9	25
47	KCG	DTW74V82974227C	88351	88356	89010	M-L	LOSKAOA2654	89033	89045	89060	5	20	23	12	15
48	KCG	DTW74V83004373B	88350	88355	89010	M-L	LOSKAOA2654	89033	89045	89049	5	21	23	12	4

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
49	KCG	DTW74V830043768	88330	88336	88358	M-G	LOSKAOA2590	89013	89026	89030	6	22	21	13	4
50	KCG	DTW74V83004380	88347	88349	89005	M-O	LOSKAOA2636	89030	89040	89044	2	22	25	10	4
51	KCG	DTW74V83004400A	88342	88356	89010	M-L	LOSKAOA2650	89033	89045	89107	14	20	23	12	62
52	KCG	DTW74V83004440c	88353	88354	89010	M-L	LOSKAOA2654	89033	89045	89049	1	22	23	12	4
53	KCG	DTW74V83004443	88326	88328	88358	M-G	LOSKAOA2592	89013	89026	89030	2	30	21	13	4
54	KCG	DTW74V830044458	88348	88349	89005	M-O	LOSKAOA2636	89030	89040	89050	1	22	25	10	10
55	KCG	DTW74V83004457	88324	88326	88338	M-F	LOSKAOA2543	88365	89009	89030	2	12	27	10	21
56	KCG	DTW74V83004459	88326	88328	88348	M-M	LOSKAOA2557	89010	89017	89023	2	20	28	7	6
57	KCG	DTW74V83004466	88326	88336	88358	M-G	LOSKAOA2595	89017	89026	89030	10	22	25	9	4
58	KCG	DTW74V83004469	88327	88333	88358	M-G	LOSKAOA2593	89017	89026	89030	6	25	25	9	4
59	KCG	DTW74V83004472	88328	88334	88358	M-G	LOSKAOA2593	89017	89026	89030	6	24	25	9	4
60	KCG	DTW74V83004482	88325	88328	88348	M-M	LOSKAOA2557	89010	89017	89030	3	20	28	7	13
61	KCG	DTW74V83004485	88326	88328	88358	M-G	LOSKAOA2592	89013	89026	89030	2	30	21	13	4
62	KCG	DTW74V83004490	88357	88362	89021	M-S	LOSKAOA2690	89053	89063	89069	5	25	32	10	6
63	KCG	DTW74V83004494	88327	88328	88358	M-G	LOSKAOA2593	89017	89026	89030	1	30	25	9	4
64	KCG	DTW74V83004497	88325	88328	88358	M-G	LOSKAOA2592	89013	89026	89030	3	30	21	13	4
65	KCG	DTW74V83004500	88326	88328	88348	M-M	LOSKAOA2557	89010	89017	89023	2	20	28	7	6
66	KCG	DTW74V83004505	88326	88328	88338	M-F	LOSKAOA2543	88365	89009	89021	2	10	27	10	12
67	KCG	DTW74V83004508A	88330	88336	88358	M-G	LOSKAOA2590	89013	89026	89030	6	22	21	13	4
68	KCG	DTW74V83004513	88326	88328	88358	M-M	LOSKAOA2557	89010	89017	89030	2	30	18	7	13
69	KCG	DTW74V83004538C	88360	88363	89021	M-S	LOSKAOA2691	89053	89063	89083	3	24	32	10	20
70	KCG	DTW74V83004547	88334	88336	88358	M-G	LOSKAOA2595	89017	89026	89044	2	22	25	9	18
71	KCG	DTW74V83004560	88346	88350	89010	M-L	LOSKAOA2650	89033	89045	89055	4	26	23	12	10
72	KCG	DTW74V83004569	88353	88356	89010	M-L	LOSKAOA2654	89033	89045	89055	3	20	23	12	10
73	KCG	DTW74V83004572	88331	88333	88348	M-M	LOSKAOA2557	89010	89017	89028	2	15	28	7	11
74	KCG	DTW74V83004580	88335	88342	88358	M-G	LOSKAOA2619	89017	89026	89044	7	16	25	9	18
75	KCG	DTW74V83004584	88330	88335	88358	M-G	LOSKAOA2614	89017	89026	89044	5	23	25	9	18
76	KCG	DTW74V83004617A	88335	88341	89010	M-L	LOSKAOA2650	89033	89045	89055	6	35	23	12	10
77	KCG	DTW74V83004618	88330	88336	88358	M-G	LOSKAOA2595	89017	89026	89044	6	22	25	9	18
78	KCG	DTW74V83004704A	88338	88344	89010	M-L	LOSKAOA2650	89033	89045	89059	6	32	23	12	14
79	KCG	DTW74V830047208	88345	88347	89005	M-O	LOSKAOA2635	89030	89040	89053	2	24	25	10	13
80	KCG	DTW74V83004759	88330	88337	88358	M-G	LOSKAOA2590	89013	89020	89044	7	21	21	7	24
81	KCG	DTW74V83004762	88330	88337	88358	M-G	LOSKAOA2590	89013	89020	89044	7	21	21	7	24
82	KCG	DTW74V83004766	88330	89004	89021	M-S	LOSKAOA2685	89052	89063	89075	40	17	31	11	12
83	KCJ	DTW74V83004249	88328	88333	88348	M-M	LOSKAOA2558	89010	89019	89027	5	15	28	9	8
84	KCJ	DTW74V83004351	88323	88326	88348	M-M	LOSKAOA2560	89010	89019	89027	3	22	28	9	8
85	KCJ	DTW74V83004356	88328	88333	88348	M-M	LOSKAOA2557	89010	89019	89034	5	15	28	9	15
86	KCJ	DTW74V83004361	88326	88333	88348	M-M	LOSKAOA2558	89010	89019	89027	7	15	28	9	8
87	KCJ	DTW74V83004364A	88337	89004	89020	M-S	LOSKAOA2703	89045	89063	89074	33	16	25	10	11
88	KCJ	DTW74V83004364C	88332	88336	88358	M-G	LOSKAOA2595	89017	89026	89060	4	22	25	9	34
89	KCJ	DTW74V83004372	88326	88333	88348	M-M	LOSKAOA2558	89010	89017	89027	7	15	28	7	10
90	KCL	DTW44V70844781	88323	88334	88348	M-M	LOSKAOA2558	89010	89017	89024	11	14	28	7	7
91	KCL	DTW44V70853557	88309	88319	88338	M-F	LOSKAOA2545	88365	89009	89018	10	19	27	10	9
92	KCL	DTW44V81154348	88335	88342	88358	M-G	LOSKAOA2618	89017	89023	89072	7	16	25	6	49
93	KCL	DTW44V814744554	88353	88364	89010	M-L	LOSKAOA2654	89030	89044	89181	11	12	20	14	137
94	KCL	DTW44V81484931	88334	88341	88358	M-G	LOSKAOA2618	89017	89023	89044	7	17	25	6	21
95	KCL	DTW44V81493528	88349	88355	89010	M-L	LOSKAOA2654	89033	89044	89054	6	21	23	11	10
96	KCL	DTW44V815044408	88344	88351	89010	M-L	LOSKAOA2653	89033	89044	89065	7	25	23	11	21

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
97	KCL	DTW44V818334350	88343	88347	89005	M-O	LOSKAOA2635	89030	89034	89059	4	24	25	4	25
98	KCL	DTW44V82054687B	88318	88320	88338	M-F	LOSKAOA2545	88365	89009	89020	2	18	27	10	11
99	KCL	DTW44V82063035	88347	88357	89010	M-L	LOSKAOA2654	89033	89044	89061	10	18	23	11	17
100	KCL	DTW44V82404169	88351	88362	89021	M-S	LOSKAOA2690	89053	89058	89069	11	25	32	5	11
101	KCL	DTW44V82404829	88325	88327	88348	M-M	LOSKAOA2558	89010	89017	89027	2	21	28	7	10
102	KCL	DTW44V82674756	88283	88348	88358	M-G	LOSKAOA2615	89017	89023	89032	65	10	25	6	9
103	KCL	DTW44V82683071	88346	88349	89005	M-O	LOSKAOA2636	89030	89034	89055	3	25	25	4	21
104	KCL	DTW44V82684053	88335	88336	88358	M-G	LOSKAOA2585	89017	89023	89030	1	22	25	6	7
105	KCL	DTW44V82974004	88313	88319	88338	M-F	LOSKAOA2545	88365	89009	89017	6	19	27	10	8
106	KCL	DTW44V82974376	88316	88323	88338	M-F	LOSKAOA2544	88365	89009	89017	7	15	27	10	8
107	KCL	DTW44V83004405	88319	88321	88348	M-M	LOSKAOA2558	89010	89017	89025	2	27	28	7	8
108	KCL	DTW44V83282001	88333	88337	88358	M-G	LOSKAOA2616	89017	89023	89027	4	21	25	6	4
109	KCL	DTW44V83293108	88334	88354	89005	M-O	LOSKAOA2634	89030	89034	89049	20	17	25	4	15
110	KCL	DTW64V733137688	88322	88323	88338	M-F	LOSKAOA2544	88365	89009	89020	1	15	27	10	11
111	KCL	DTW64V818136938	88323	88327	88358	M-G	LOSKAOA2592	89013	89025	89031	4	31	21	12	6
112	KCL	DTW64V81813693C	88332	88336	88358	M-G	LOSKAOA2595	89017	89025	89031	4	22	25	8	6
113	KCL	DTW64V82043654	88322	88323	88338	M-F	LOSKAOA2544	88365	89009	89020	1	15	27	10	11
114	KCL	DTW64V82663731	88325	88332	88358	M-G	LOSKAOA2593	89017	89025	89030	7	28	25	8	5
115	KCL	DTW64V83003610	88319	88322	88348	M-M	LOSKAOA2559	89010	89017	89026	3	26	28	7	9
116	KCL	DTW64V83293792	88344	88354	89005	M-O	LOSKAOA2634	89030	89044	89052	10	17	25	14	8
117	KCL	DTW74V71763940	88324	88328	88358	M-G	LOSKAOA2593	89017	89026	89046	4	30	25	9	20
118	KCL	DTW74V72694805	88344	88350	89010	M-L	LOSKAOA2653	89033	89045	89055	6	26	23	12	10
119	KCL	DTW74V73323030	88327	88337	88358	M-G	LOSKAOA2616	89017	89026	89045	10	21	25	9	19
120	KCL	DTW74V735249960	88319	88323	88338	M-F	LOSKAOA2544	88365	89009	89027	4	15	27	10	18
121	KCL	DTW74V80573390	88357	88365	89020	M-S	LOSKAOA2706	89053	89063	89079	8	21	33	10	16
122	KCL	DTW74V80584400C	88307	88319	88335	M-U	LOSKAOA2516	88355	88362	89018	12	16	20	7	22
123	KCL	DTW74V80873416	88341	88343	88358	M-G	LOSKAOA2614	89017	89026	89033	2	15	25	9	7
124	KCL	DTW74V81193462	88326	88334	88358	M-G	LOSKAOA2593	89017	89026	89167	8	24	25	9	141
125	KCL	DTW84V80563616	88326	88328	88358	M-G	LOSKAOA2593	89017	89025	89044	2	30	25	8	19
126	KCL	DTW84V81183299	88253	88319	88338	M-F	LOSKAOA2544	88365	89009	89024	66	19	27	10	15
127	KCL	DTW84V81813884C	88328	88334	88348	M-M	LOSKAOA2558	89010	89018	89044	6	14	28	8	26
128	KCL	DTW84V82393352C	88322	88327	88358	M-G	LOSKAOA2592	89017	89025	89044	5	31	25	8	19
129	KCL	DTW84V82393558	88343	88347	89010	M-L	LOSKAOA2653	89033	89047	89054	4	29	23	14	7
130	KCL	DTW84V82663581A	88318	88321	88338	M-F	LOSKAOA2543	88365	89009	89024	3	17	27	10	15
131	KCN	DTW44V72393054C	88336	88342	88358	M-G	LOSKAOA2618	89017	89023	89033	6	16	25	6	10
132	KCN	DTW44V72413258	88192	88322	88338	M-F	LOSKAOA2544	88365	89009	89017	130	16	27	10	8
133	KCN	DTW64V53303707	88334	88337	88358	M-G	LOSKAOA2615	89017	89025	89032	3	21	25	8	7
134	KCN	DTW64V82974069	88329	88341	88358	M-G	LOSKAOA2591	89013	89025	89031	12	17	21	12	6
135	KCN	DTW64V82974074	88324	88334	88358	M-G	LOSKAOA2593	89017	89025	89031	10	24	25	8	6
136	KCN	DTW64V82974078	88327	88337	88358	M-G	LOSKAOA2616	89017	89025	89031	10	21	25	8	6
137	KCN	DTW64V82974110	88328	88333	88348	M-M	LOSKAOA2558	89010	89017	89023	5	15	28	7	6
138	KCN	DTW64V829741178	88326	88341	88358	M-G	LOSKAOA2591	89013	89025	89031	15	17	21	12	6
139	KCN	DTW64V829741224	88328	88333	88358	M-G	LOSKAOA2593	89017	89025	89031	5	25	25	8	6
140	KCN	DTW64V83003611	88329	88341	88358	M-G	LOSKAOA2591	89013	89025	89030	12	17	21	12	5
141	KCN	DTW64V83003614	88328	88333	88348	M-M	LOSKAOA2558	89010	89017	89028	5	15	28	7	3
142	KCN	DTW64V83003615C	88348	88350	89010	M-L	LOSKAOA2651	89033	89044	89049	4	26	23	11	5
143	KCN	DTW64V83003634C	88325	88334	88348	M-M	LOSKAOA2558	89010	89017	89020	9	14	28	7	3
144	KCN	DTW64V830036402	88332	88336	88358	M-G	LOSKAOA2595	89017	89025	89030	4	22	25	8	5

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
145	KCN	DTW74V72064554	88299	88326	88348	M-M	LOSKAOA2560	89010	89017	89044	27	22	28	7	27
146	KCN	DTW74V82974156	88324	88326	88338	M-F	LOSKAOA2544	88365	89009	89034	2	12	27	10	25
147	KCN	DTW74V82974165	88329	88337	88358	M-G	LOSKAOA2615	89017	89026	89051	8	21	25	9	25
148	KCN	DTW74V82974172	88324	88326	88348	M-M	LOSKAOA2560	89010	89017	89031	2	22	28	7	14
149	KCN	DTW74V82974206	88323	88327	88348	M-M	LOSKAOA2558	89010	89017	89031	4	21	28	7	14
150	KCN	DTW74V82974214B	88339	88341	88358	M-G	LOSKAOA2618	89017	89026	89041	2	17	25	9	15
151	KCN	DTW74V82974241	88323	88341	88358	M-G	LOSKAOA2618	89017	89026	89058	18	17	25	9	32
152	KCN	DTW74V82974254	88324	88328	88358	M-G	LOSKAOA2592	89013	89026	89044	4	30	21	13	18
153	KCN	DTW74V82974266	88329	88337	88358	M-G	LOSKAOA2615	89017	89026	89041	8	21	25	9	15
154	KCN	DTW74V83003001	88327	88345	88358	M-G	LOSKAOA2615	89017	89026	89045	18	13	25	9	19
155	KCN	DTW74V83003019	88326	88328	88348	M-M	LOSKAOA2558	89010	89017	89027	2	20	28	7	10
156	KCN	DTW74V83003029	88320	88328	88348	M-M	LOSKAOA3558	89010	89017	89027	8	20	28	7	10
157	KCN	DTW74V83003456	88345	88347	88358	M-G	LOSKAOA2615	89017	89026	89074	2	11	25	9	48
158	KCN	DTW74V83004040	88324	88326	88338	M-F	LOSKAOA2544	88365	89009	89031	2	12	27	10	22
159	KCN	DTW74V83004043	88323	88326	88348	M-M	LOSKAOA2558	89010	89017	89031	3	22	28	7	14
160	KCN	DTW84V62713375A	88335	88357	89010	M-L	LOSKAOA2651	89033	89047	89059	22	19	23	14	12
161	KCN	DTW74V83004143	88329	88347	88358	M-G	LOSKAOA2615	89017	89026	89058	18	11	25	9	32
162	KCN	DTW84V72063513U	88347	88349	89005	M-O	LOSKAOA2636	89030	89047	89055	2	22	25	17	8
163	KCW	DTW44V83294769	88358	89003	89020	M-S	LOSKAOA2703	89054	89062	89080	11	17	34	8	18
164	KCW	DTW44V83304507	88361	89005	89020	M-S	LOSKAOA2710	89054	89062	89077	10	15	34	8	15
165	KCW	DTW44V83304517	88365	89004	89020	M-S	LOSKAOA2689	89053	89058	89069	5	16	33	5	11
166	KCW	DTW44V83304582	88359	88363	89010	M-L	LOSKAOA2652	89033	89044	89052	4	13	23	11	8
167	KCW	DTW44V83304651B	88365	89004	89020	M-S	LOSKAOA2687	89053	89058	89069	5	16	33	5	11
168	KCW	DTW44V83304726	88357	88362	89010	M-L	LOSKAOA2652	89033	89044	89052	5	14	23	11	8
169	KCW	DTW44V83304932	88364	89004	89020	M-S	LOSKAOA2687	89053	89058	89079	6	16	33	5	21
170	KCW	DTW44V83304985	88359	88365	89020	M-S	LOSKAOA2706	89053	89062	89086	6	21	33	9	24
171	KCW	DTW44V83313079	88357	88362	89020	M-S	LOSKAOA2690	89053	89058	89073	5	24	33	5	15
172	KCW	DTW44V83574384	88364	89003	89020	M-S	LOSKAOA2703	89054	89062	89081	5	17	34	8	19
173	KCW	DTW64V83293859	88363	89003	89020	M-S	LOSKAOA2687	89053	89058	89062	6	17	33	5	4
174	KCW	DTW64V83293884C	88365	89003	89020	M-S	LOSKAOA2688	89053	89058	89069	4	17	33	5	11
175	KCW	DTW64V83293920	88357	88364	89020	M-S	LOSKAOA2705	89053	89061	89072	7	22	33	8	11
176	KCW	DTW64V83533725	88362	89003	89020	M-S	LOSKAOA2703	89054	89062	89069	7	17	34	8	7
177	KCW	DTW64V83533765	88365	89003	89020	M-S	LOSKAOA2688	89053	89058	89069	4	17	33	5	11
178	KCW	DTW64V83533816	88360	89004	89020	M-S	LOSKAOA2687	89053	89058	89069	10	16	33	5	11
179	KCW	DTW64V83544279	88364	89003	89020	M-S	LOSKAOA2703	89054	89063	89076	5	17	34	9	13
180	KCW	DTW64V83574102	88365	89003	89020	M-S	LOSKAOA2687	89053	89063	89069	4	17	33	10	6
181	KCW	DTW74V83293601	88363	88365	89020	M-S	LOSKAOA2686	89053	89063	89075	2	21	33	10	12
182	KCW	DTW74V83294352	88357	88365	89020	M-S	LOSKAOA2686	89053	89063	89075	8	21	33	10	12
183	KCW	DTW74V83294967	88357	88362	89010	M-L	LOSKAOA2652	89033	89045	89059	5	14	23	12	14
184	KCW	DTW74V83294978	88357	88363	89021	M-S	LOSKAOA2691	89053	89063	89079	6	24	32	10	16
185	KCW	DTW74V83303068	88360	89004	89021	M-S	LOSKAOA2687	89053	89063	89077	10	17	32	10	14
186	KCW	DTW74V83303575	88357	88362	89021	M-S	LOSKAOA2690	89053	89063	89076	5	25	32	10	13
187	KCW	DTW74V83303974	88357	89003	89021	M-S	LOSKAOA2703	89054	89063	89076	12	18	33	9	13
188	KCW	DTW74V83303989	88357	88362	89010	M-L	LOSKAOA2652	89033	89045	89058	5	14	23	12	13
189	KCW	DTW74V83304036	88358	88365	89021	M-S	LOSKAOA2706	89053	89063	89076	7	22	32	10	13
190	KCW	DTW74V83304065	88365	89003	89021	M-S	LOSKAOA2688	89053	89063	89076	4	18	32	10	13
191	KCW	DTW74V83304099	88357	88362	89021	M-S	LOSKAOA2652	89053	89063	89076	5	25	32	10	13
192	KCW	DTW74V83304417	88357	88364	89021	M-S	LOSKAOA2686	89053	89063	89076	7	23	32	10	13

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
193	KCW	DTW74V83304158	88358	88363	89010	M-L	LOSKAOA2652	89033	89045	89055	5	13	23	12	10
194	KCW	DTW74V83304371	88358	89003	89021	M-S	LOSKAOA2703	89054	89061	89094	11	18	33	7	33
195	RNC	DTW44473023067	88318	88322	88348	M-M	LOSKAOA2559	89010	89017	89027	4	26	28	7	10
196	RNC	DTW444B3014205	88326	88328	88358	M-G	LOSKAOA2592	89013	89021	89031	2	30	21	8	10
197	RNE	DTW44473303005A	88351	88362	89021	M-S	LOSKAOA2690	89053	89058	89065	11	25	32	5	7
198	RNE	DTW44473324540	88340	88341	88358	M-G	LOSKAOA2618	89017	89023	89027	1	17	25	6	4
199	RNG	DTW44471633940	88357	88362	89010	M-L	LOSKAOA2652	89033	89044	89057	5	14	23	11	13
200	RNG	DTW44471633998	88341	88343	88358	M-G	LOSKAOA2618	89017	89023	89034	2	15	25	6	11
201	RNG	DTW44473534032	88327	88336	88358	M-G	LOSKAOA2591	89013	89023	89067	9	22	21	10	44
202	RNG	DTW44471632030	88309	88314	88348	M-M	LOSKAOA2558	89010	89017	89027	5	34	28	7	10
203	RNG	DTW444B0243058	88291	88341	88358	M-G	LOSKAOA2617	89017	89023	89032	50	17	25	6	9
204	RNG	DTW44471633703	88334	88340	88358	M-G	LOSKAOA2615	89017	89023	89044	6	18	25	6	21
205	RNG	DTW44481194649	88333	88343	88358	M-G	LOSKAOA2619	89017	89023	89031	10	15	25	6	8
206	RNG	DTW44481484557	88351	88357	89010	M-L	LOSKAOA2654	89033	89044	89052	6	19	23	11	8
207	RNG	DTW44481493193	88344	88364	89020	M-G	LOSKAOA2705	89053	89062	89079	20	22	33	9	17
208	RNG	DTW44483004394	88327	88333	88358	M-G	LOSKAOA2593	89017	89023	89031	6	25	25	6	8
209	RNG	DTW74481173028	88298	88299	88322	M-S	LOSKAOA2467	88347	88362	89018	1	23	25	15	22
210	RNG	DTW74481173030	88335	88342	88358	M-G	LOSKAOA2618	89017	89026	89059	7	16	25	9	33
211	KBS	DTW54V82974015	88347	88350	89005	M-O	LOSKEEA5718	89030	89031	89042	3	21	25	1	11
212	KBS	DTW54V82974142	88322	88326	88348	M-M	LOSKEEA5587	89014	89018	89033	4	22	32	4	15
213	KBS	DTW54V83003097	88321	88326	88348	M-M	LOSKEEA5559	89014	89018	89032	5	22	32	4	14
214	KBS	DTW54V83003103	88330	88336	88358	M-G	LOSKEEA5635	89023	89025	89034	6	22	31	2	9
215	KBS	DTW54V830031268	88326	88337	88358	M-G	LOSKEEA5636	89023	89025	89032	11	21	31	2	7
216	KBS	DTW54V83003147C	88365	89004	89021	M-S	LOSKEEA5801	89053	89056	89067	5	17	32	3	11
217	KBS	DTW54V83003183	88322	88333	88348	M-M	LOSKEEA5596	89014	89018	89032	11	15	32	4	14
218	KBS	DTW54V830031988	88322	88327	88348	M-M	LOSKEEA5559	89014	89018	89027	5	21	32	4	9
219	KBS	DTW54V83003227	88322	88326	88338	M-F	LOSKEEA5549	89009	89010	89018	4	12	37	1	8
220	KBS	DTW54V83003247	88324	88334	88358	M-G	LOSKEEA5635	89023	89025	89033	10	24	31	2	8
221	KBU	DTW54V83003317	88328	88333	88348	M-M	LOSKEEA5596	89014	89018	89032	5	15	32	4	14
222	KBU	DTW54V83003342	88326	88333	88348	M-M	LOSKEEA5586	89014	89018	89042	7	15	32	4	24
223	KBU	DTW54V83003369	88330	88337	88358	M-G	LOSKEEA5637	89023	89025	89042	7	21	31	2	17
224	KBU	DTW54V83003396	88324	88334	88348	M-M	LOSKEEA5596	89014	89018	89026	10	14	32	4	8
225	KBU	DTW54V83003426	88334	88335	88358	M-G	LOSKEEA5616	89020	89025	89042	1	23	28	5	17
226	KBU	DTW54V83003476	88325	88334	88348	M-M	LOSKEEA5586	89014	89018	89045	9	14	32	4	27
227	KBU	DTW54V83003505	88324	88333	88348	M-M	LOSKEEA5596	89014	89018	89042	9	15	32	4	24
228	KBU	DTW54V83003729A	88339	88347	89005	M-O	LOSKEEA5718	89030	89031	89042	8	24	25	1	11
229	KBU	DTW54V83003749	88345	88351	89010	M-L	LOSKEEA5743	89042	89044	89053	6	25	32	2	9
230	KBU	DTW54V83003817	88323	88327	88348	M-M	LOSKEEA5559	89014	89018	89033	4	21	32	4	15
231	KBU	DTW54V83003835	88323	88327	88348	M-M	LOSKEEA5559	89014	89018	89033	4	21	32	4	15
232	KBU	DTW54V83003869	88334	88341	88358	M-G	LOSKEEA5637	89023	89025	89034	7	17	31	2	9
233	KBU	DTW54V83003877	88329	88341	88358	M-G	LOSKEEA5634	89023	89025	89034	12	17	31	2	9
234	KBU	DTW54V83003915	88324	88328	88348	M-M	LOSKEEA5559	89014	89018	89032	4	20	32	4	14
235	KBU	DTW54V83003939	88325	88334	88348	M-M	LOSKEEA5586	89014	89018	89032	9	14	32	4	14
236	KCG	DTW54V72393205	88357	88363	89021	M-S	LOSKEEA5774	89053	89055	89067	6	24	32	2	12
237	KCG	DTW54V82974152	88336	88341	88358	M-G	LOSKEEA5636	89023	89025	89035	5	17	31	2	10
238	KCG	DTW54V83003987	88339	88343	88358	M-G	LOSKEEA5664	89023	89025	89034	4	15	31	2	9
239	KCG	DTW54V83004023	88348	88350	89005	M-O	LOSKEEA5718	89030	89031	89047	4	21	25	1	16
240	KCG	DTW54V83004158	88334	88335	88358	M-G	LOSKEEA5616	89020	89025	89034	1	23	28	5	9

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

ItemCase	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
241 KCG	DTW54V83004198	88330	88335	88358	M-G	LOSKEEA5635	89023	89025	89035	5	23	31	2	10
242 KCG	DTW54V83004230	88334	88342	88358	M-G	LOSKEEA5664	89023	89025	89034	8	16	31	2	9
243 KCG	DTW54V83004282	88351	88357	89005	M-O	LOSKEEA5759	89030	89031	89044	6	14	25	1	13
244 KCG	DTW54V83004305	88330	88335	88348	M-M	LOSKEEA5595	89014	89018	89032	5	13	32	4	14
245 KCG	DTW54V83004338	88349	88356	89010	M-L	LOSKEEA5743	89042	89044	89051	7	20	32	2	7
246 KCG	DTW54V83004642	88333	88337	88358	M-G	LOSKEEA5618	89020	89025	89034	4	21	28	5	9
247 KCG	DTW54V83004669	88357	88365	89021	M-S	LOSKEEA5775	89053	89055	89070	8	22	32	2	15
248 KCG	DTW54V83014334	88330	88335	88358	M-M	LOSKEEA5595	89014	89018	89031	5	23	22	4	13
249 KCG	DTW54V83014421	88334	88335	88358	M-G	LOSKEEA5616	89020	89025	89035	1	23	28	5	10
250 KCG	DTW54V830144678	88336	88342	88358	M-G	LOSKEEA5637	89023	89025	89035	6	16	31	2	10
251 KCG	DTW54V83014477	88330	88335	88348	M-M	LOSKEEA5595	89014	89018	89031	5	13	32	4	13
252 KCG	DTW54V83014509	88330	88335	88358	M-G	LOSKEEA5635	89023	89025	89035	5	23	31	2	10
253 KCG	DTW54V83014521	88331	88335	88358	M-G	LOSKEEA5635	89023	89025	89051	4	23	31	2	26
254 KCG	DTW54V83014879	88330	88337	88358	M-G	LOSKEEA5636	89023	89025	89067	7	21	31	2	42
255 KCG	DTW54V83014951	88330	88335	88358	M-G	LOSKEEA5635	89023	89025	89042	5	23	31	2	17
256 KCG	DTW54V83014980	88330	88335	88348	M-G	LOSKEEA5595	89014	89018	89058	5	13	32	4	40
257 KCG	DTW54V83023008	88334	88335	88358	M-G	LOSKEEA5616	89020	89025	89033	1	23	28	5	8
258 KCG	DTW54V83023023	88334	88341	88358	M-G	LOSKEEA5634	89023	89025	89033	7	17	31	2	8
259 KCG	DTW54V83023026	88334	88335	88358	M-G	LOSKEEA5616	89020	89025	89033	1	23	28	5	8
260 KCG	DTW54V83023042	88334	88335	88348	M-M	LOSKEEA5595	89014	89018	89032	1	13	32	4	14
261 KCL	DTW54V61453308C	88314	88321	88338	M-F	LOSKEEA5535	89009	89010	89018	7	17	37	1	8
262 KCL	DTW54V723933088	88307	88309	88339	M-U	LOSKEEA5485	89009	89010	89015	2	30	36	1	5
263 KCL	DTW54V72693341	88344	88347	88358	M-G	LOSKEEA5664	89023	89025	89033	3	11	31	2	8
264 KCL	DTW54V73053431	88309	88321	88338	M-F	LOSKEEA5512	89009	89010	89018	12	17	37	1	8
265 KCL	DTW54V73523191	88351	88355	89010	M-L	LOSKEEA5742	89042	89044	89048	4	21	32	2	4
266 KCL	DTW54V73524098	88330	88337	88358	M-G	LOSKEEA5636	89023	89025	89037	7	21	31	2	12
267 KCL	DTW54V73564032	88351	88355	89010	M-L	LOSKEEA5742	89042	89044	89047	4	21	32	2	3
268 KCL	DTW54V80253091	88357	88365	89021	M-S	LOSKEEA5804	89053	89055	89067	8	22	32	2	12
269 KCL	DTW54V805632858	88343	88348	88358	M-G	LOSKEEA5664	89023	89025	89033	5	10	31	2	8
270 KCL	DTW54V80564630A	88309	88319	88338	M-F	LOSKEEA5535	89009	89010	89018	10	19	37	1	8
271 KCL	DTW54V814732238	88356	88363	89021	M-S	LOSKEEA5774	89053	89055	89067	7	24	32	2	12
272 KCL	DTW54V81474350C	88349	88355	89010	M-L	LOSKEEA5743	89042	89044	89051	6	21	32	2	7
273 KCL	DTW54V81813177A	88305	88307	88339	M-U	LOSKEEA5485	88356	88357	89005	2	32	17	1	14
274 KCL	DTW54V81813874B	88236	88342	88358	M-G	LOSKEEA5634	89023	89025	89033	106	16	31	2	8
275 KCL	DTW54V81833700	88315	88319	88338	M-F	LOSKEEA5535	89009	89010	89017	4	19	37	1	7
276 KCL	DTW54V82043164	88334	88336	88358	M-G	LOSKEEA5636	89023	89025	89034	2	22	31	2	9
277 KCL	DTW54V820434118	88315	88321	88338	M-F	LOSKEEA5512	89009	89010	89019	6	17	37	1	9
278 KCL	DTW54V82043984	88351	88357	89010	M-L	LOSKEEA5742	89042	89044	89051	6	19	32	2	7
279 KCL	DTW54V82063400	88362	88363	89021	M-S	LOSKEEA5772	89053	89055	89073	1	24	32	2	18
280 KCL	DTW54V82393717C	88306	88312	88339	M-U	LOSKEEA5485	89009	89010	89026	6	27	36	1	16
281 KCL	DTW54V82394270	88350	88354	89010	M-L	LOSKEEA5743	89042	89044	89051	4	22	32	2	7
282 KCL	DTW54V82663133	88299	88306	88339	M-U	LOSKEEA5485	89009	89010	89018	7	33	36	1	8
283 KCL	DTW54V82663294	88322	88327	88338	M-M	LOSKEEA5559	89014	89018	89027	5	11	42	4	9
284 KCL	DTW54V82663489	88323	88327	88338	M-M	LOSKEEA5587	89014	89018	89034	4	11	42	4	16
285 KCL	DTW54V82663919C	88336	88342	89005	M-O	LOSKEEA5718	89030	89031	89042	6	29	25	1	11
286 KCL	DTW54V82664220C	88345	88349	89005	M-O	LOSKEEA5877	89030	89031	89044	4	22	25	1	13
287 KCL	DTW54V82664645	88315	88317	88348	M-M	LOSKEEA5587	89014	89018	89032	2	31	32	4	14
288 KCL	DTW54V826831490	88312	88314	88338	M-F	LOSKEEA5485	88356	88357	89018	2	24	18	1	27

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
289	KCL	DTW54V826837734	88333	88337	88358	M-G	LOSKEEA5616	89020	89025	89034	4	21	28	5	9
290	KCL	DTW54V82744070	88342	88349	89005	M-O	LOSKEEA5677	89030	89031	89042	7	22	25	1	11
291	KCL	DTW54V82974325	88312	88319	88338	M-F	LOSKEEA5535	89009	89010	89018	7	19	37	1	8
292	KCL	DTW54V83003374A	88312	88315	88339	M-U	LOSKEEA5404	88356	88357	89019	3	24	17	1	28
293	KCL	DTW54V83023076A	88311	88319	88338	M-F	LOSKEEA5535	89009	89010	89025	8	19	37	1	15
294	KCL	DTW94V831920018	88323	88327	88348	M-M	LOSKEEA5559	89014	89018	89027	4	21	32	4	9
295	KCL	DTW94V832620018	88330	88334	88348	M-M	LOSKEEA5586	89014	89018	89027	4	14	32	4	9
296	KCN	DTW54V60874346	88327	88337	88358	M-G	LOSKEEA5616	89020	89025	89035	10	21	28	5	10
297	KCN	DTW54V83003265	88335	88341	88358	M-M	LOSKEEA5637	89023	89025	89051	6	17	31	2	26
298	KCN	DTW54V83003281	88323	88328	88348	M-M	LOSKEEA5559	89014	89018	89026	5	20	32	4	8
299	KCN	DTW54V83023086	88337	88340	88348	M-M	LOSKEEA5856	89053	89055	89067	3	8	71	2	12
300	KCN	DTW54V83023118	88328	88333	88348	M-M	LOSKEEA5586	89014	89018	89026	5	15	32	4	8
301	KCN	DTW54V83023137	88329	88337	88358	M-G	LOSKEEA5636	89023	89025	89051	8	21	31	2	26
302	KCN	DTW54V83023148	88323	88328	88348	M-M	LOSKEEA5559	89014	89018	89032	5	20	32	4	14
303	KCN	DTW54V830231686	88324	88327	88348	M-M	LOSKEEA5559	89014	89018	89032	3	21	32	4	14
304	KCN	DTW54V83023195	88323	88327	88348	M-M	LOSKEEA5559	89014	89018	89032	4	21	32	4	14
305	KCN	DTW54V83023219	88326	88334	88358	M-M	LOSKEEA5596	89014	89018	89051	8	24	22	4	33
306	KCW	DTW54V83293151	88362	88365	89021	M-S	LOSKEEA5804	89053	89056	89073	3	22	32	3	17
307	KCW	DTW54V83293224	88358	88365	89021	M-S	LOSKEEA5802	89053	89056	89067	7	22	32	3	11
308	KCW	DTW54V83293286	88364	89004	89021	M-S	LOSKEEA5801	89053	89056	89066	6	17	32	3	10
309	KCW	DTW54V83293530	88357	88365	89021	M-S	LOSKEEA5801	89053	89056	89070	8	22	32	3	14
310	KCW	DTW54V83293619	88358	88363	89021	M-S	LOSKEEA5772	89053	89056	89097	5	24	32	3	41
311	KCW	DTW54V83293948	88357	88362	89021	M-S	LOSKEEA5801	89053	89056	89066	5	25	32	3	10
312	KCW	DTW54V83294001	88363	89003	89021	M-S	LOSKEEA5773	89053	89056	89065	6	18	32	3	9
313	KCW	DTW54V83294058	88358	88365	89021	M-S	LOSKEEA5804	89053	89056	89070	7	22	32	3	14
314	KCW	DTW54V83294073	88363	88365	89021	M-S	LOSKEEA5804	89053	89056	89070	2	22	32	3	14
315	KCW	DTW54V83294178	88357	88363	89010	M-L	LOSKEEA5751	89042	89044	89065	6	13	32	2	21
316	KCW	DTW54V83294247	88363	89003	89021	M-S	LOSKEEA5772	89053	89056	89067	6	18	32	3	11
317	KCW	DTW54V83294296	88362	88364	89021	M-S	LOSKEEA5772	89053	89056	89067	2	23	32	3	11
318	KCW	DTW54V83294474	89010	89011	89021	M-S	LOSKEEA5853	89053	89056	89090	1	10	32	3	24
319	KCW	DTW54V83294505	88358	88363	89010	M-L	LOSKEEA5751	89042	89044	89051	5	13	32	2	7
320	KCW	DTW54V83294613B	88357	88362	89021	M-S	LOSKEEA5801	89053	89056	89070	5	25	32	3	14
321	KCW	DTW54V83294672	88358	88365	89021	M-S	LOSKEEA5801	89053	89056	89072	7	22	32	3	16
322	KCW	DTW54V83304804	88365	89004	89021	M-S	LOSKEEA5803	89053	89056	89067	5	17	32	3	11
323	KCW	DTW54V83304879	88362	88363	89021	M-S	LOSKEEA5774	89053	89056	89070	1	24	32	3	14
324	KCW	DTW54V833131738	88358	88363	89010	M-L	LOSKEEA5751	89042	89044	89051	5	13	32	2	7
325	KCW	DTW54V83313404	88357	88365	89021	M-S	LOSKEEA5775	89053	89056	89097	8	22	32	3	41
326	KCW	DTW54V83324032	88364	89004	89021	M-S	LOSKEEA5801	89053	89056	89066	6	32	32	3	10
327	KCW	DTW94V83313953	88357	88365	89021	M-S	LOSKEEA5772	89053	89056	89082	8	22	32	3	26
328	KCW	DTW94V83313955	89006	89011	89021	M-S	LOSKEEA5854	89053	89056	89082	5	10	32	3	26
329	KCW	DTW94V833139580	88357	88365	89021	M-S	LOSKEEA5772	89053	89056	89082	8	22	32	3	26
330	KCW	DTW94V83313961	89006	89011	89021	M-S	LOSKEEA5854	89053	89056	89082	5	10	32	3	26
331	KCW	DTW94V83313972	89006	89011	89021	M-S	LOSKEEA5854	89053	89056	89082	5	10	32	3	26
332	KCW	DTW94V83554341	88363	89003	89021	M-S	LOSKEEA5772	89053	89056	89082	6	18	32	3	26
333	KCW	DTW94V83554354	88363	88365	89021	M-S	LOSKEEA5801	89053	89056	89082	2	22	32	3	26
334	KCW	DTW94V835820018	88365	89004	89021	M-S	LOSKEEA5802	89053	89056	89081	5	17	32	3	25
335	RNE	DTW54451702901	88351	88354	89010	M-U	LOSKEEA5743	89042	89044	89110	3	22	32	2	66
336	RNE	DTW54453151591	88099	88306	88339	M-U	LOSKEEA5485	88356	88357	89003	207	33	17	1	12

Appendix A: Samples and Data Collected for ROCAF FNS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
337	RNE	DTW544711763199	88335	88340	88358	M-G	LOSKEEA5636	89023	89025	89035	5	18	31	2	10
338	RNE	DTW544724D4977	88336	88347	88358	M-G	LOSKEEA5664	89023	89025	89069	11	11	31	2	44
339	RNE	DTW544B2993047	88336	88341	88358	M-G	LOSKEEA5636	89023	89025	89051	5	17	31	2	26
340	RNE	DTW544535T4221	88341	88349	89005	M-O	LOSKEEA5718	89030	89031	89059	8	22	25	1	28
341	RNG	DTW544716321S6	88299	88306	88339	M-U	LOSKEEA5485	88356	88357	89008	7	33	17	1	18
342	RNG	DTW544716322J1	88357	88363	89021	M-S	LOSKEEA5774	89053	89056	89067	6	24	32	3	11
343	RNG	DTW544716321B5	88355	88365	89021	M-S	LOSKEEA5804	89053	89056	89067	10	22	32	3	11
344	RNG	DTW544716322Z9	88323	88334	88348	M-N	LOSKEEA5586	89014	89018	89027	11	14	32	4	9
345	RNG	DTW544716322G8	88319	88328	88348	M-N	LOSKEEA5587	89014	89018	89083	9	20	32	4	65
346	RNG	DTW544716322J3	88323	88334	88348	M-N	LOSKEEA5596	89014	89018	89032	11	14	32	4	14
347	RNG	DTW544716323Z2	88350	88355	89010	M-L	LOSKEEA5743	89042	89044	89053	5	21	32	2	9
348	RNG	DTW544716323S9	88329	88336	88358	M-G	LOSKEEA5636	89023	89025	89035	7	22	31	2	10
349	RNG	DTW544716323B5	88336	88341	88358	M-G	LOSKEEA5637	89023	89025	89035	5	17	31	2	10
350	RNG	DTW544716325S5	88306	88313	88338	M-F	LOSKEEA5512	89009	89010	89018	7	25	37	1	8
351	RNG	DTW544716325Z2	88338	88347	89005	M-O	LOSKEEA5718	89030	89031	89042	9	24	25	1	11
352	RNG	DTW544716325B3	88344	88347	89005	M-O	LOSKEEA5718	89030	89031	89048	3	24	25	1	17
353	RNG	DTW544716325Q0	88311	88328	88348	M-N	LOSKEEA5559	89014	89018	89035	17	20	32	4	17
354	RNG	DTW544716326200	88349	88355	89010	M-L	LOSKEEA5743	89042	89044	89051	6	21	32	2	7
355	RNG	DTW544716326630	88307	88314	88338	M-F	LOSKEEA5535	89009	89010	89018	7	24	37	1	8
356	RNG	DTW544716326708	88350	88354	89010	M-L	LOSKEEA5743	89042	89044	89051	4	22	32	2	7
357	RNG	DTW544716326948	88296	88307	88339	M-U	LOSKEEA5485	88356	88357	89005	11	32	17	1	14
358	RNG	DTW544805632222	88335	88340	88358	M-G	LOSKEEA5636	89023	89025	89035	5	18	31	2	10
359	RNG	DTW544808532264	88355	88365	89021	M-S	LOSKEEA5804	89053	89056	89067	10	22	32	3	11
360	RNG	DTW544814732344	88335	88340	88358	M-G	LOSKEEA5636	89023	89025	89035	5	18	31	2	10
361	KBS	DTW44V830141G1	88326	88333	88364	M-L	NYCKAOA3666	89033	89044	89052	7	31	35	11	8
362	KCE	DTW44V633133B0	88279	88314	88364	M-L	NYCKAOA3666	89033	89044	89053	35	50	35	11	9
363	KCE	DTW44V632740Z0	88355	88363	89038	M-M	NYCKAOA3917	89064	89081	89101	8	41	26	17	20
364	KCJ	DTW44V830041A5	88323	88333	88364	M-L	NYCKAOA3666	89033	89045	89058	10	31	35	12	13
365	KCL	DTW44V713820I3	88300	88306	88364	M-L	NYCKAOA3666	89033	89044	89052	6	58	35	11	8
366	KCL	DTW44V812033B3	88301	88314	88364	M-L	NYCKAOA3666	89033	89044	89107	13	50	35	11	63
367	KCL	DTW44V814933Z3	88323	88333	88364	M-L	NYCKAOA3666	89033	89044	89059	10	31	35	11	15
368	KCL	DTW44V818246I7	88318	88321	88364	M-L	NYCKAOA3666	89033	89044	89052	3	43	35	11	8
369	KCL	DTW44V818341G0	88315	88319	88364	M-L	NYCKAOA3666	89033	89044	89086	4	45	35	11	42
370	KCL	DTW44V820637D8	88315	88319	88364	M-L	NYCKAOA3666	89033	89044	89059	4	45	35	11	15
371	KCL	DTW44V826647J7	88297	88316	88364	M-L	NYCKAOA3666	89033	89044	89054	19	48	35	11	10
372	KCL	DTW44V826832Y5	88321	88327	88364	M-L	NYCKAOA3666	89033	89044	89061	6	37	35	11	17
373	KCL	DTW44V830233I3	88347	88349	89007	M-S	NYCKAOA3726	89054	89062	89086	2	24	47	8	24
374	KCL	DTW64V811836988	88291	88314	88364	M-L	NYCKAOA3666	89033	89044	89052	23	50	35	11	8
375	KCL	DTW74V8058440D8	88323	88350	89007	M-S	NYCKAOA3726	89055	89063	89080	27	23	48	8	17
376	KCL	DTW74V808636I6	88337	88347	89007	M-S	NYCKAOA3726	89054	89063	89074	10	26	47	9	11
377	KCL	DTW74V8087342B8	88180	88306	88364	M-L	NYCKAOA3666	89033	89045	89055	126	58	35	12	10
378	KCL	DTW74V811939Y3	88315	88316	88364	M-L	NYCKAOA3666	89033	89045	89058	1	48	35	12	13
379	KCL	DTW74V818147S8	88302	88341	88364	M-L	NYCKAOA3666	89033	89045	89059	39	23	35	12	14
380	KCL	DTW74V818242I8	88340	88343	89007	M-S	NYCKAOA3726	89054	89063	89074	3	30	47	9	11
381	KCL	DTW74V818343T1	88314	88350	89007	M-S	NYCKAOA3726	89054	89063	89079	36	23	47	9	16
382	KCL	DTW74V826642B1	88287	88314	88364	M-L	NYCKAOA3666	89033	89045	89058	27	50	35	12	13
383	KCL	DTW74V826730A4	88324	88341	88364	M-L	NYCKAOA3666	89033	89045	89059	17	23	35	12	14
384	KCL	DTW74V826736Y9	88287	88314	88364	M-L	NYCKAOA3666	89033	89045	89062	27	50	35	12	17

Appendix A: Samples and Data Collected for ROCAF FMS Distribution System

Item	Case	Document Number	S1	R1	S2	Vsl	B/L	R2	S3	R3	S1-R1	R1-S2	S2-R2	R2-S3	S3-R3
385	KCL	DTW74V82684235	88309	88319	88364	M-L	NYCKAOA3666	89033	89045	89060	10	45	35	12	15
386	KCL	DTW74V82684547A	88291	88314	88364	M-L	NYCKAOA3666	89033	89045	89060	23	50	35	12	15
387	KCL	DTW74V83023712	88319	88347	89007	M-S	NYCKAOA3726	89054	89063	89074	28	26	47	9	11
388	KCL	DTW84V80563628C	88307	88333	88364	M-L	NYCKAOA3666	89033	89047	89059	26	31	35	14	12
389	KCN	DTW64V830036158	88327	88341	88364	M-L	NYCKAOA3665	89033	89044	89049	14	23	35	11	5
390	KCN	DTW84V533033628	88309	88320	88364	M-L	NYCKAOA3665	89033	89047	89059	11	44	35	14	12
391	RNE	DTW44453294019	88304	88319	88364	M-L	NYCKAOA3665	89033	89046	89058	15	45	35	13	12
392	RNE	DTW44463014014	88304	88319	88364	M-L	NYCKAOA3665	89033	89046	89058	15	45	35	13	12
393	RNG	DTW44473534968	88288	88314	89007	M-S	NYCKAOA3726	89054	89062	89079	26	59	47	8	17
394	RNG	DTW64471632493	88315	88327	89007	M-S	NYCKAOA3726	89054	89062	89065	12	46	47	8	3
395	SHA	DTW44462886662	88355	89003	89038	M-M	NYCKAOA3915	89074	89081	89107	14	35	36	7	26
396	SHA	DTW44472646604	88355	89003	89038	M-M	NYCKAOA3915	89074	89081	89115	14	35	36	7	34
397	SHA	DTW44472026679	88355	89003	89038	M-M	NYCKAOA3915	89074	89083	89173	14	35	36	9	90
398	SHA	DTW44472026712	88355	89003	89038	M-M	NYCKAOA3915	89074	89081	89173	14	35	36	7	92
399	KBS	DTW54V320744828	88344	88350	89015	M-U	NYCKEEA3563	89068	89073	89097	6	31	53	5	24
400	KBS	DTW54V83003073	88323	88333	89015	M-U	NYCKEEA3563	89068	89073	89097	10	48	53	5	24
401	KBS	DTW54V83003111	88323	88333	89015	M-U	NYCKEEA3563	89068	89073	89093	10	48	53	5	20
402	KBS	DTW54V71193614	88339	88343	89015	M-U	NYCKEEA3563	89068	89073	89102	4	38	53	5	29
403	KCL	DTW54V61793892	88312	88316	88341	M-G	NYCKEEA3349	89023	89025	89045	4	25	48	2	20
404	KCL	DTW54V73314672	88313	88321	88351	M-O	NYCKEEA3427	89030	89031	89042	8	30	45	1	11
405	KCL	DTW54V80564021	88298	88347	89015	M-U	NYCKEEA3563	89068	89073	89097	49	34	53	5	24
406	KCL	DTW54V81474340	88313	88321	88351	M-O	NYCKEEA3427	89030	89031	89042	8	30	45	1	11
407	KCL	DTW54V81493793	88305	88308	88351	M-O	NYCKEEA3427	89030	89031	89042	3	43	45	1	11
408	KCL	DTW54V81834208	88305	88308	88351	M-O	NYCKEEA3427	89030	89031	89042	3	43	45	1	11
409	KCL	DTW54V81834214	88302	88308	88351	M-O	NYCKEEA3427	89030	89031	89042	6	43	45	1	11
410	KCL	DTW54V82043369	88308	88322	89015	M-U	NYCKEEA3563	89066	89068	89094	14	59	51	2	26
411	KCL	DTW54V82394141	88287	88314	88341	M-G	NYCKEEA3349	89023	89025	89034	27	27	48	2	9
412	KCL	DTW54V82413089	88252	88299	88322	M-F	NYCKEEA3248	89009	89010	89026	47	23	53	1	16
413	KCL	DTW54V82663271	88305	88308	88331	M-M	NYCKEEA3310	89014	89018	89027	3	23	49	4	9
414	KCL	DTW54V82663392	88287	88314	88342	M-G	NYCKEEA3349	89023	89025	89042	27	28	47	2	17
415	KCL	DTW54V82663427	88291	88294	88313	M-U	NYCKEEA3188	88356	88357	89018	3	19	43	1	27
416	KCL	DTW54V82663453	88287	88314	88342	M-G	NYCKEEA3349	89023	89025	89032	27	28	47	2	7
417	KCL	DTW54V82664014	88287	88314	88342	M-G	NYCKEEA3349	89023	89025	89033	27	28	47	2	8
418	KCL	DTW54V82683761	88302	88308	88331	M-M	NYCKEEA3310	89014	89018	89031	6	23	49	4	13
419	KCL	DTW54V82744162	88287	88314	88342	M-G	NYCKEEA3349	89023	89025	89033	27	28	47	2	8
420	RNE	DTW54473023061A	88268	88300	88322	M-F	NYCKEEA3248	89009	89010	89014	32	22	53	1	4

Notes: 1. Vsl = Vessel Name

2. Vessel Names:

a. M-F = Ming Fortune
b. M-G = Ming Galaxy
c. M-L = Ming Longevity
d. M-M = Ming Moon
e. M-O = Ming Ocean
f. M-S = Ming Star
g. M-U = Ming Universe

Appendix B: Vessel Schedule for Yang Ming Line

Item	Vsl Name	Voy NO.	N.Y.	L.A.	KAO	KEE	NY-LA	LA-KAO	KAO-KEE	Total
1.	M-O	46W	88282	88297	88317	88321	15	20	4	39
2.	M-P	06W	88294	88312	88329	88332	18	17	3	38
3.	M-St	48W	88304	88321	88339	88343	17	18	4	39
4.	M-E	32W	88313	88330	88348	88352	17	18	4	39
5.	M-F	32W	88322	88339	88357	88360	17	18	3	38
6.	M-M	49W	88331	88348	88366	89005	17	18	5	40
7.	M-G	48W	88341	88358	89010	89014	17	18	4	39
8.	M-O	47W	88351	89002	89020	89024	17	18	4	39
9.	M-P	07W	88362	89010	89027	89031	14	17	4	35
10.	M-St	49W	89007	89021	89038	89042	14	17	4	36
11.	M-U	47W	88313	88330	88348	88352	17	18	4	39
12.	M-U	48W	89017	89031	89046	89051	14	15	5	34
13.	M-F	33W	89025	89039	89056	89059	14	17	3	34
14.	M-M	50W	89035	89049	89069	89073	14	20	4	38
15.	M-L	33W	88364	89012	89028	89032	14	16	4	34
16.	M-Su	52W	89023	89037	89053	89065	14	16	12	42

Notes:

1. Vsl = Vessel
2. Voy = Voyage
3. L.A.= Los Angeles
4. N.Y.= New York
5. KAO = Kaohsiung
6. KEE = Keelung
7. Vessel Names:

a. M-E = Ming Energy
b. M-F = Ming Fortune
c. M-G = Ming Galaxy
d. M-L = Ming Longevity
e. M-M = Ming Moon
f. M-O = Ming Ocean
g. M-P = Ming Plenty
h. M-St = Ming Star
i. M-Su = Ming Sun
j. M-U = Ming Universe

Appendix C: Glossary of Acronyms

AFLC	- Air Force Logistics Command
ALC	- Air Logistics Center
CCBL	- Collect Commercial Bill of Lading
CCNAA	- Coordination Council for North American Affairs
CSF	- Combined Service Forces
DAAS	- Defense Automatic Addressing System
DAASO	- Defense Automatic Addressing System Office
DLA	- Defense Logistics Agency
DOD	- Department of Defense
DPD	- Defense Procurement Division
FLO	- Foreign Liaison Office
FMS	- Foreign Military Sales
GSA	- General Services Administration
ILC	- International Logistics Center
ILCS	- International Logistics Communication System
IRDF	- Issue/Receipt Data Form
LCC	- Logistics Control Center
MILSTRIP	- Military Standard Requisitioning and Issue Procedures
NAVILCO	- US Navy International Logistics Center
NMCS	- Not Mission Capable-Supply
NOA	- Notice of Availability
NSN	- National Stock Number
POL	- Petroleum, Oil and Lubricant
ROCAF	- Republic of China Air Force

ROD	- Report of Discrepancy
SA	- Security Assistance
SAMIS	- Security Assistance Management Information System
STARR/PC	- Supply Tracking and Reparable Return/Personal Computer
TCN	- Transportation Control Number
UPS	- United Parcel Service
USAF	- UNited States Air Force
WPAFB	- Wright-Patterason Air Force Base

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His military service included these positions: Aircraft Maintenance Officer at First Air Depot in Kaohsiung and First Tactical Fighter Wing in Tainan, Chief of Jet Engine Shop at Fourth Tactical Fighter Wing in Chia Yi and Liaison/Protocol Officer at GHQ ROCAF in Taipei.

He made the very first trip to the United States to attend a jet engine course at Williams AFB, Arizona, in 1974. His second tour to U.S.A. was to attend the Aircraft Maintenance Officer Course at Chanute AFB, Illinois, in 1977. Almost a decade later, he had another opportunity to visit the United States again in July 1986. This time, He was assigned as ROCAF's Liaison Officer to HQ Air Force Logistics Command at Wright-Patterson AFB, Ohio. He attended AFIT as a part-time student while stationed at WPAFB.

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This study had two objectives:

1. To analyze the ROCAF FMS distribution system and to identify its problems and causes, whenever possible. And
2. To make recommendations based on the findings of this research.

A total of four hundred and twenty (420) samples were collected for this study. These data were analyzed by using descriptive statistics to examine in detail the material's flow time at each individual link of the ROCAF FMS distribution system--starting from the shipment of materials by the sources of supply, through the freight forwarder and ROCAF's two transportation stations, till they were received by ROCAF's end users. Detailed discussions were presented under twenty-one (21) investigative questions.

Some problems or bottlenecks of the distribution system were revealed by this study. The causes of those problems were traced and could be categorized as process, manpower, management or equipment related.

Although the ROCAF FMS distribution system was plagued with some problems, there are certain ways that can be used to rid it of such problems and to enable materials to move smoothly through the entire system. Those possible solutions were proposed by this research. Finally, some recommendations for future research were also made.